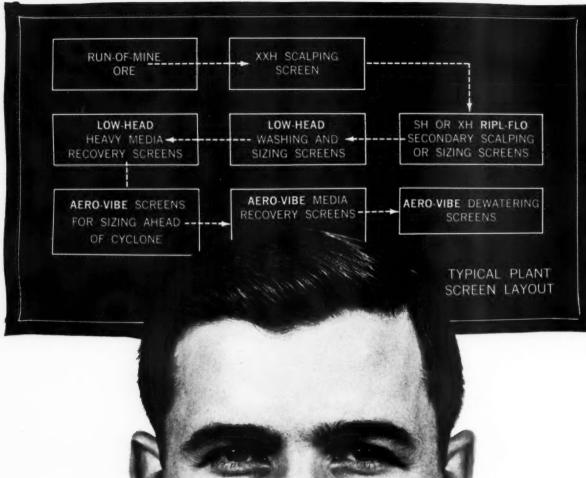
MINING



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Analyze your plant flow, screen by screen:

How much are your screens costing you?

Short cuts in cost can only lead to trouble. There's no "safe" spot where you can economize on equipment. And this certainly applies to screens. They're an important part of the day-in, day-out dependability you have to have throughout your system.

All of your screening operations — scalping, sizing, washing, dewatering, media recovery — carry full responsibility for continuous, uninterrupted flow. To live up to this responsibility, your system needs screens

that are engineered to do each specific job. A-C engineering has done just that — with a complete line of screens that assure you top performance under the most rugged conditions.

Ask your A-C representative about the specific features that make A-C screens a dependable part of your system. Or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. A-1370

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For media drain and dewatering in cyclone plants — AVS Aero-Vibe inclined screen.



Coarse to fine sizing (wet or dry), rinsing, washing, dewatering and media recovery — Low-Head horizontal screen saves headroom too.



For scalping and coarse sizing, wet or dry — XH Ripl-Flo rugged cost saving inclined screen.



For light scalping, coarse or fine sizing (wet or dry) rinsing or washing — SH Ripl-Flo inclined screen.



For tough primary scalping jobs and high tonnage — XXH ROM inclined screen.



MINING CONGRESS JOURNAL

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AUGUST 1961

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Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

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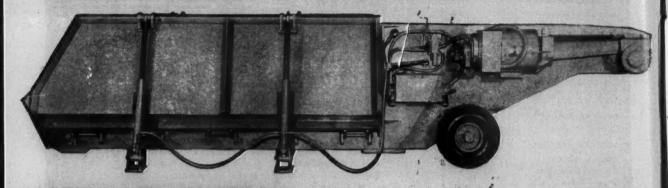
ON OUR COVER

Snohomish County, Washington, north of Seattle, was in years past the State's second ranking gold producing area. Although the importance of gold mining has receded, the small, individual miner still plays an important part in our country's most basic industry. Seattle and the Pacific Northwest are playing host to the American Mining Congress Convention beginning September 10. See page 33 for full details.

Published Monthly, Yearly subscriptions, United States, Canada, Central and South America, \$3.00. Foreign, \$10.00. Single copies, \$0.75. February Annual Review Issue, \$1.25. Second class postage paid at Washington, D. C., and at additional Post Office, Lancaster, Pennsylvania.



EXTRA TRIPS AND EXTRA TONS EVERY SHIFT





WITH THE NATIONAL MINE



You can write your own ticket for increased production with National Mine's TransFeeder-in some mines as much as 60 tons per shift. The TransFeeder takes the shuttle car load at full discharge rate (TorKars discharge in 22 to 25 seconds), releasing the car for another trip, then automatically feeds the load at a pre-set rate to belt or mine car. Lost time, spillage, conveyor jogging, damage and undue belt wear are avoided completely and your shuttle cars can cycle as fast as haulage and loading conditions permit. Rugged construction, ample power and TorKar quality components make the TransFeeder a selfamortizing and rewarding addition to your present production equipment. Ask your National Mine man for details-or write!

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THIS MONTH

-MCJ Presents -and the

THUNDERBIRD

The customer "influenced" the mining system, type of equipment and method of preparation at Thunderbird, Indiana's newest major underground coal mine. The mine supplies 1,300,000 tons of coal annually to the Breed Station of the Indiana and Michigan Electric Co. A detailed description of the mine appears on page 48.

PRACTICAL DUST CONTROL

In any underground operation where dust control is of concern, a thorough knowledge of ventilation, rock wettability, and dust characteristics is of fundamental importance. Methods of dust control at the Anaconda Company's Montana operations are described in an illustrated report beginning on page 54.

LATEST DEVELOPMENTS FOR CONTINUOUS ANALYSIS

One of the recent breakthroughs in coal preparation technology has been the introduction of various apparatus for the rapid analysis of ash, sulphur and moisture in coal. This is a big step toward completely automatic coal preparation plants. See page 58.

ELECTRICAL DISTRIBUTION AT THE ESPERANZA CONCENTRATOR

Following the trend in modern ore processing plants, the Esperanza concentrator of Duval Sulphur & Potash Co. purchases electrical energy from a local utility. Details of the main substation, switchgear, power centers, large motors and controls, and 480-volt motor controls are described. Reasons behind equipment selection and the choice of 4160 distribution voltage are also discussed. The complete story starts on page 63.

(Continued on pages 4-5)

AUTHORS



W. A. Endicott entered the mining profession in 1921 as mine clerk for United Electric Coal Corp. He joined Ayrshire Collieries Corp. as assistant superintendent in 1929, and has been general superintendent of Ayrshire since 1951.

Frank J. Laird, Jr., joined the Anaconda Co. in 1946 as an assistant mining engineer. He was later assistant head unit mining engineer before becoming assistant ventilation engineer. He is currently assistant chief ventilation & industrial hygiene engineer.





Loy A. Updegraff is a graduate in mechanical engineering from Ohio State University. Practically all of his career has been spent in the coal industry, primarily in coal preparation and research. Before joining Bituminous Coal Research, Inc. eight years ago, he was associated

with Roberts & Schaefer Co. in its coal preparation division.

H. A. London joined Duval Sulphur & Potash Co. in 1951 as mechanical superintendent. For eleven years prior to that, he was with Westinghouse Electric Corp. T. A. Hohing has



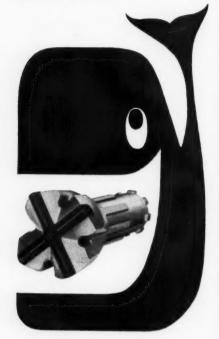


H. A. London

T. A. Hohing

been in district engineering for Westinghouse Electric Corp. since 1954 and is presently stationed in Denver. He has been with the company since 1949.

APPETITE



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Wherever widely spaced, large diameter blast holes can be used these 4 1/2"; 5", 6", 61/2"; 7" and 9" Brunner and Lay Spline Rok-Master bits will produce sensational results. They simply extend the proved economies of all Brunner & Lay carbide bits to larger hole sizes. They give the Brunner & Lay line complete coverage of all drilling tools from chuck to muck. Pit them against those you now use, you'll wish you had sooner.

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This Month (continued) —and the

PRACTICAL ASPECTS OF CONTROLLING AN UNDERGROUND FIRE ON A MINING MACHINE

Fire! That's a soul-chilling call, especially underground. The U.S. Bureau of Mines has experimented in ways to put out mining machine fires underground and prepared a report on the subject. See page 70.

THE ALLENDALE STORY

Stonefort Coal Mining Co. has opened up a new strip mine near Wyoming, Ill. Equipped with a revamped 950B stripping shovel and a brand new preparation plant, it is turning out upwards of 3000 tons of coal per shift. A description of the mine begins on page 74.

DEVELOPMENTS IN LARGE BOREHOLE DRILLING

Olga Coal Co. faced two problems at its deep West Virginia mines—removing methane gas and providing adequate escapeways. The answer was large diameter boreholes. Since 1949 the company has drilled seven holes, ranging up to 76 in. in diameter and up to 976 ft deep, and has realized substantial savings over conventional shaft sinking. A description of this work begins on page 77.

WHAT THE MANAGEMENT CONSULTANT CAN DO FOR THE MINING INDUSTRY

Management consultants can provide a flexibility in mine management that is often impossible to attain in any other way. Wide experience, knowledge of effective skills and techniques, and analytical ability enable the consultant to diagnose problems and offer suggestions for their solution. See page 81.

BLASTING VIBRATIONS IN **QUARRY OPERATIONS**

Houdaille Construction Materials, Inc., has developed a number of procedures to alleviate complaints resulting from blasting vibrations at its five quarries located in densely populated areas of New Jersey. These techniques have done much to reduce the number of complaints, and the company has what it feels is a safe and correct blasting program. For the entire story see page 84.

AUTHORS

Donald W. Mitchell has been with the Bureau of Mines since 1951. In addition to working at the Experimental mine he has spent several years in coal mine rehabilitation abroad and making mine and mineral site investigations in the United States. Edwin M. Murphy joined the Bureau in 1946 working



Murphy joined the Bureau in 1946, working D. W. Mitchell with Synthetic Liquid Fuels. Since 1957 he has been at the Experimental mine. John Nagy has been with the Bureau since 1936, working on factors affecting safety in coal mining, and industrial dust explosion research.

Glenn F. Jackson of the American Mining Congress staff prepared the interesting report on Allendale.

H. Eugene Mauck is vice president operations, Freeman Coal Mining Corp., having previously been general superintendent of operations,





H. E. Mauck

D. C. Ridenour

Olga Coal Co. He has been associated with the coal industry since boyhood. David C. Ridenour is general superintendent of Olga Coal Co., having joined the company in 1949. For ten years before that, he was with Pittsburgh Coal Co., a division of Consolidation Coal Co.



Sherrill A. Parsons is managing partner of the western region of the management consulting firm of Booz, Allen & Hamilton which he joined in 1941. For the previous five years he was engaged in management consulting for Standard Oil Co. of Indiana.

Daniel J. Miller, Jr., has been associated with various subsidiaries of Houdaille Industries Inc. for 15 years. A registered professional engineer, he has been chiefly occupied in designing, building and operating construction materials processing plants.





A FAVORITE FOR CONSTRUCTION, MINING AND MILITARY surveys. The reading system, fully illuminated, features a scale microscope direct to 1' and better than 20" by estimation. Repetitions are made with a circle clamp, eliminating upper and lower motions. Simple operation and reading, ruggedness, and highest Wild precision in optics and mechanics combine to make the T-16 your best choice in this type instrument...by far!



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"RATIO-FEEDER" saves us 20 seconds in the unloading of each shuttle car...

we have found your Ratio-Feeder to be a very valuable piece of machinery in our Thunderbird Mine," says WILBUR A. ENDICOTT, General Superintendent, Ayrshire Collieries Corp.



1. Shuttle car unloads at its maximum discharge rate into a Ratio-Feeder in Ayrshire's Thunderbird Mine. The 20 seconds saved increases mine output...extends shuttle car haul distance...lowers cost per ton.



2. "The wide intake conveyor of the Ratio-Feeder takes the full load of the shuttle car with a minimum of spillage and holds down clean up costs," General Superintendent Endicott reports.

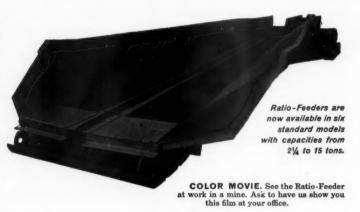


3. Ratio-Feeder discharges at a uniform rate reducing belt overloading, damage and wear. "It can be set to proportion the coal so that several panels can unload onto the same belt without stopping any one of the others," says Mr. Endicott.



4. Ready for the next shuttle car. This Ratio-Feeder was installed in September 1959, had handled 250,000 tons of coal when picture was taken 6 months later. Two more Ratio-Feeders have since been installed in the Thunderbird Mine.

The Ratio-Feeder is now demonstrating in mine after mine that it is the answer to the age-old problem of getting coal from a shuttle car to a belt...fast... without damage to the belt... increasing belt haulage capacity...and with a minimum of spillage. The advantages that Ayrshire Collieries and other well-known mines are getting from the Ratio-Feeder can be yours too. It will cost you nothing at all to get the complete proved facts as to where this timesaving machine is working and what it is accomplishing...and what it can do for you. Simply write or call us.





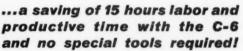


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MATERIALS HANDLING EQUIPMENT SPECIALISTS FOR 75 YEARS





C-6	Crawler "C"		
Planetary Gears 3 hours	Gears and Bearings 16 hours		
Inside pinion and drive gear reduction 11 hours	Top pinion from steering clutch with bearing and shaft 13 hours Total 29 hours		

Times shown are for removal and replacement of final drive with all components in place.

With a 15 hour saving for final drive replacement the "Euc" C-6 gives you 15 hours more productive time on the job! Easy accessibility that's designed into the C-6 and Euclid's time-tested planetary drive save hours of repair labor... that means less downtime and more production. Compare these savings in terms of lower costs... add the

extra hours available for work on the job . . . then you'll see what just this one advantage can do in cutting operating cost.

The Euclid dealer in your area would like to prove that the C-6 is the lowest cost tractor in the 200 h.p. class... and the most versatile by far. He's sure of it, and wants you to know the facts, too!





DIVISION OF GENERAL MOTORS, HUDSON, OHIO Plants at Cleveland and Hudson, Ohio and Lanarkshire, Scotland



This is
AMERICAN OIL COMPANY
in action



BY C. L. "CHARLIE" BROWN

About the Author. Charlie Brown is a lubrication specialist. His eleven years of experience in such work are only part of his qualifications. He majored in math and physics at Eastern Illinois State College and he has completed the Company's Sales Engineering School.

On the coal washing equipment at Crown Mine they were experiencing trouble with the lubrication of the air valves. Because the grease wasn't getting in to do the lubrication job, valves were sticking. Working with the General Top Foreman, we recommended Rykon Grease "R." This is a grease with unique properties. It flows like an oil, but the shearing action exerted by working pressures irreversably converts the fluid to a grease. Since switching to Rykon Grease "R" in the washing jigs there's been no grease leakage and the valves work freely.

This is one instance where we helped solve a problem. But our big job was surveying the lubrication needs of the preparation plant at the time it was built. This was done and lubrication recommendations were made to insure the most economical operation of the plant. We solved the mine's problems on inventories, too. With warehouse facilities only 12 miles from the plant, we're able to keep supplies of needed products available for immediate delivery. This cuts inventory costs and provides insurance against having to wait for deliveries.

Is this the kind of product performance and service you're looking for? Get it by calling the American Oil Company office near you.

Quick facts about RYKON. Grease "R"

- Flows like an oil. Under shearing action converts to grease.
- Resists moisture and protects against corrosion.
- Stable under high temperatures.
- Mechanically and chemically stable.



AMERICAN OIL COMPANY

910 SOUTH MICHIGAN AVENUE CHICAGO 80, ILLINOIS

Get in the plant and find out how things are going, American Oil representative Charlie Brown does this. Here he discusses lubrication with Bob Boyett (right), Crown Mine General Top Foreman.



helped solve a lot of **lubrication** problems at Crown Mine

FOR EFFECTIVE ACID LEACHING OF URANIUM ORE



SODIUM CHLORATE

PENNSALT OXIDANT PROGRAM

A Pennsalt sponsored program started in 1959 at the Colorado School of Mines Research Foundation, Inc., Golden, Colorado provides valuable process and other laboratory data on the use of oxidants in uranium ore processing. This program supplements Pennsalt's 20 years of development and experiences in uses of sodium chlorate as an oxidant.

Consult Pennsalt's Technical Service Department on your specific problem.

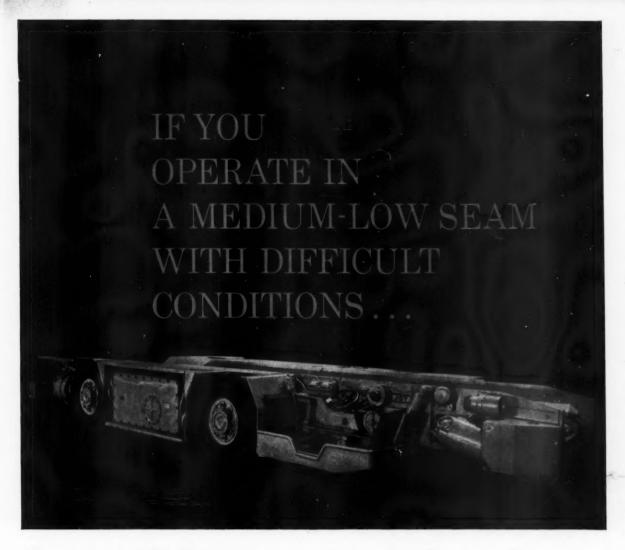
Here is the most effective oxidizing agent for acid leaching. Pennsalt sodium chlorate forms a true concentrated solution . . . permitting simple handling . . . ease of metering . . . and it is economical. Shipped in 55 gallon, 18 gauge full open head shipping drums that can be used to ship yellow cake.

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Joy 16-SC four-wheel shuttle car

Under the most difficult working conditions of heavy loads, uneven grades and bad bottom, the 4-wheel 16-SC stays in top working order. It's deliberately built to take a pounding with wheel units that are 53% stronger than ever before.

The two standard DC traction motors are 7½ hp each. For unusually steep grades or heavy loads, larger motors may be supplied. Optional motors for DC cars are 10 hp series-wound; on AC cars, they

are 20/20 hp. All motors and working parts are easy to reach for inspection and maintenance.

The 16-SC's basic height is 33 inches. With four inch sideboards it will handle 155 cu. ft. of coal. Two other models, one just 30½" high, have the same extra-rugged construction. Conveyor widths are available to 56". Ask your Joy engineer about applying the proper 16-SC to your most difficult haulage problems. He has complete information.



WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING MACHINERY









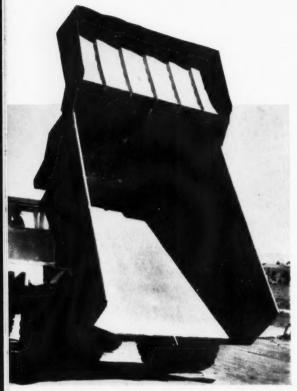




Joy Manufacturing Company Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

Proof that LW Haulpak®



This body has been hauling rock for over 4500 HOURS





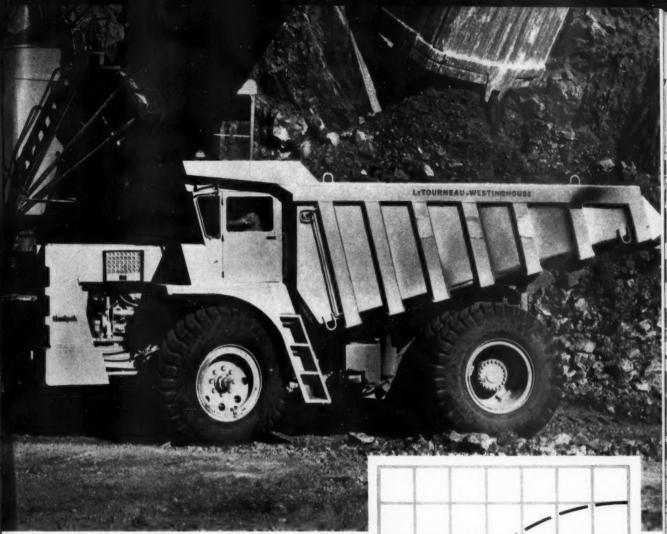
... and look at these tires after 4500 HOURS' USE

An important reason why LeTourneau-Westinghouse Haulpak trucks give you lowest cost per ton-mile is because they need few repairs . . . work longer hours between maintenance stops. Consider the bowl . . .

Shown here is a 32-ton Haulpak body after 4500 hours of hard service — carrying 790,000 tons of ore and rocky overburden on hauls up to 10,000 ft*. Look at the super-strength 100,000 psi-yield floor. It's as good as new! Yet, on same operation, trucks with conventional-design bodies required constant repair and maintenance. Now look at the tires on this LW Haulpak...

Like the body, these tires have over 4500 hours' use on them. As you can see, they still have plenty of miles left! Owner reports tires on Haulpak last twice as long per ton-mile as those on other trucks operating on the same haul. Reason for this welcome added bonus: Hydrair® suspension. This exclusive air-hydraulic suspension system also cushions load and road shocks, keeps load riding level. Eliminated are springs, front-axle, and related maintenance.

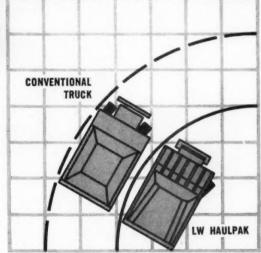
*Owner's name on request



Notice how exclusive V-shaped Haulpak body provides big capacity within short wheelbase. Also gives Haulpak lowest center of gravity, solid stability on turns and side-slope operations.

More reasons why LW Haulpaks deliver steady output and need little attention: Double-reduction axle eliminates planetary "hot box" inside rear wheels; Short heavy-duty drive train has half as many gears as ordinary trucks, needs 15% less hp to turn than other drive-trains; Dry-type air cleaner removes up to 99.8% of dust for efficient engine performance; Bolt-circle wheel mounting for easy service, less trouble. Aircraft type multi-disc brakes offer four times more stopping surface than most haulers.

Why not let your LeTourneau-Westinghouse Distributor give you all the facts on Haulpak. He'll also be happy to arrange a demonstration. 5 end-dump sizes, 22 to 65 tons. 90-ton bottom-dump also available.



1/2 shorter turn circle

In addition to a smoother ride and increased tire life, Hydrair suspension permits front wheels to turn at a sharp 45° angle \dots because there are no spring or axle obstructions. Result: Haulpak turns in $\frac{1}{3}$ less space than comparable-capacity haulers, and much shorter than many smaller rigs. You spot faster at load and dump, complete more cycles per shift!

HP-2424-G-2r

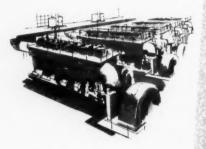


LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

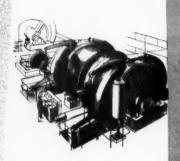
Where quality is a habit

NORDBERG MINING MACHINERY



FOR POWER GENERATION

Nordberg engines are built in sizes from small 10 horsepower units to over 12,000 horsepower... and are available for Diesel, Duafuel® and Sparklignition Gas operation.



FOR HOISTING

Nordberg has an established reputation second to none, and can furnish both conventional and friction type mine hoists for men and material, to meet specific requirements.



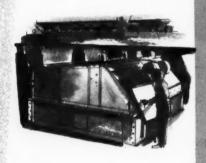
FOR PRIMARY CRUSHING

Symons® Primary Gyratory Crushers are built for big tonnage, heavy duty primary breaking in 30", 42", 48", 54", 60", and 72" feed opening sizes. Capacities to 3500 or more tons per hour.



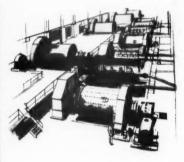
FOR REDUCTION CRUSHING

Symons Cone Crushers are built in both Standard and Short Head types, in sizes from 22" to 10' in diameter. Capacities to 1500 or more tons per hour.



FOR SCREENING

From scalping to fine screening, there is a Symons Screen built to do a better job at low cost. Let Nordberg experience help you select the screen best suited to your needs.



FOR WET AND DRY GRINDING

Nordberg Grinding Mills include Rod, Ball, Pebble, Tube and Compartment types, in sizes from 6' to 13' in diameter and up to 50' in length.

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"One Man One Machine LOAD HAUL DUMP"

Underground filmed report shows how one mine moves hard rock for less than 20¢ a ton . . .

You have probably heard of the Young Mine of American Zinc, Lead and Smelting Company and wanted to see their operation. It is believed to be one of the world's most economically-operated hard rock mines. Many have come to observe their methods, several from foreign countries. This mine operates two shifts. A total of only 95 hourly employees produce more than 3,000 tons daily. The low cost operation is the primary result of the tremendous tonnage moved by self-loading transports manufactured by Sanford-Day. Three of these S-D Transloaders, requiring only three men per shift, load, haul, and dump all the ore produced. Total cost is less than 20¢ a ton. This includes cost of original investment, maintenance and labor. Another feature of this mine that visitors observe and ask questions about with a great deal of interest is the haulage equipment. Only 28 S-D Automatic Bottom Dumping mine cars are necessary to haul the entire 3,000-ton daily production to tipple and it costs less than 4¢ a ton. We recently completed and have available now for your study a documentary 18-minute color-sound 16mm movie showing every phase of this low cost operation — from drilling to transportation of ore to mill. Ask us to mail this film to you for showing to your operating personnel...or, ask us to have one of our representatives bring projector and the movie to show for you. Write or call us today. Use coupon below to make mail request.

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— We have sound projector. Please mail film "One — Please have your represe	entative contact r	ne. W
We have sound projector. Please mail film "One Man! One Machine! LOAD HAUL DUMP" direct for review and study. Please have your repress would like to have him v "One Man! One Machine!	isit us to show th	e movi

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CITY_____STATE____



INSTANTLY CONTROLLABLE CUTTING HEIGHTS

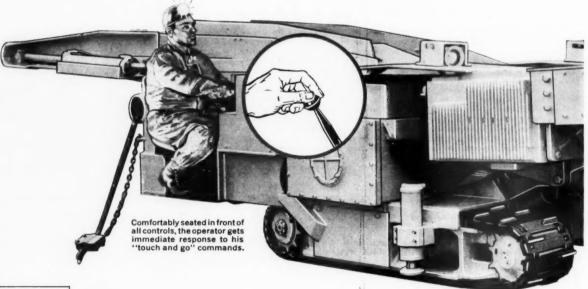
Lee-Morse CM38





Here's the modern Miner with "touch and go" vertical action. Hydraulically controlled to follow uneven seam conditions.

This feature mines high and low coal seams from 42 inches to 120 inches for hundred percent extraction.





Lee-Norse Company CHARLEROI, PENNA.
SPECIALISTS IN COAL MINING EQUIPMENT

Coal High or Low?... Lee-Novie MINERS keep production on the go!

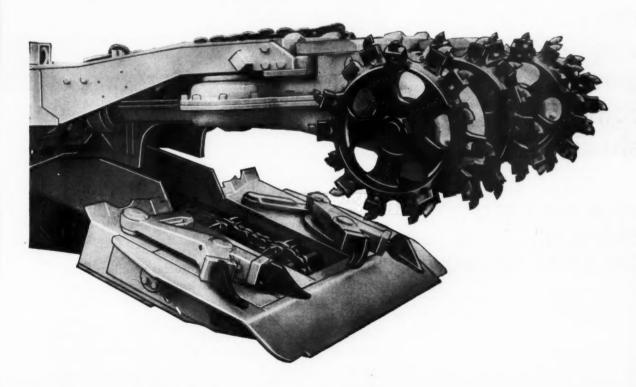
and CM48 MINERS

gives the Lee-Norse Miners these 3 features:

1. CONTROLLABLE CUTTING HEIGHTS 2. SELECTIVE MINING ABILITY 3. TRAMS LOW-CUTS HIGH

The powerful, spinning, oscillating cutters respond instantly to the operator's command to follow and cut the seam's varying heights.

The Miner quickly mills out space for a loading station . . . provides greater working area—all by "touch and go" control.



How

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can match your needs exactly...

scalping
sizing
dewatering
washing
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conveying
shaking out

YOUR H-R FIELD ENGINEER CAN SHOW YOU HOW...



Sharp sizing at low cost. Two-bearing, "circle-throw", originated by H-R, is simple and effective. Changing stroke, speed, or angle for different conditions can be easily done in field by your own men. Latest design techniques result in balanced design of all components. Full-floating principle gives smooth, quiet operation. Trunnion yoke and coil spring supports effectively eliminate vibration. Floor-mounted or suspended. Sizes: from 2' x 4' to 8' x 24'. Bulletin 122D.

*HIGH SPEED VIBREX . . .

Fine sizing, washing and dewatering at openings from 10 to 100 mesh. Oil lubricated vibrator has 1/64" thru 1/4" stroke range at speeds to 3600 rpm. Adaptable for wide range of materials. Sizes: 31 x 71 and 41 x 71.



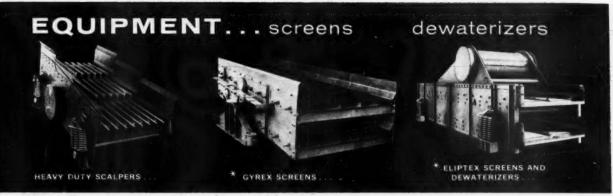
Extra heavy-duty feeder can be combined with scalping by addition of adjustable opening grizzly bar section. Only two main parts: the vibrator and a one-piece pan weldment with or without grizzly section. Variable feed control conveys material from 0 to full capacity. Low discharge height increases conveyor belt life. Coil springs absorb all impact forces. No daily maintenance. Sizes: from 2¹ x 4¹ (light duty) to 6¹ x 30¹ (heavy duty). Bulletin 169A.

VIBRATING CONVEYORS...

Smooth, dependable conveying of practically any material over longer distances for less cost, because Hewitt-Robins balanced vibration principle uses less horsepower than other makes of similar length and capacity. Sizes: from 8" pan width (light duty) to 48" pan width (heavy duty). Bulletin 135A.

His authority? Over 13,000 Hewitt-Robins vibrating screens, feeders, conveyors and shakeouts are operating in all parts of the world. From this outstanding experience Hewitt-Robins has learned how to design and manufacture vibrating equipment low in upkeep and high in reliability and economy.

An H-R field engineer or distributor is near you. Give him a call or write Hewitt-Robins, Stamford, Connecticut.

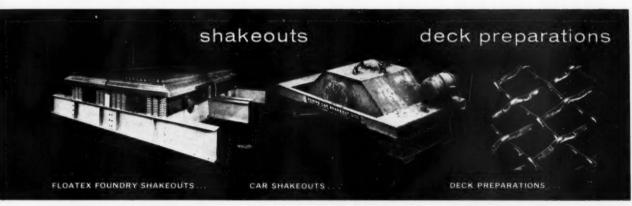


Massive, heavy; rugged: Handles 10,000 lb lumps and up to 54" cubes dropped 7 feet at openings from 2" to 14". Heavy grid frames supported on deep section 1-beams with cast steel, perforated plate or grizzly bar decks. ½" thick 24" high skirtboards. Multiple corner coil spring mounting absorbs impact and vibration. Sizes: from 3' x 6' to 8' x 20'. Bulletin 131.

Smooth operating, positive stroke vibrating screen with a long operating life. High capacity assured by central vibrator location and easy angle adjustment. Wide range of sizes and styles with one, two, or three decks. Floor-mounted or suspended. Sizes: from 4' x 6' to 6' x 16'. Bulletin 115B.

With three-way elliptical motion, sizes, washes, dewaters a wide range of materials with high accuracy and efficiency. Horizontal installation saves space, power, machinery. Special alloy, forged, self-counterweighted, full-width shafts; premium helical gears; full-floating vibration. Low power requirements. Single, double or triple deck units. Floor-mounted or suspended. Sizes: from 3¹ x 8¹ to 8¹ x 24¹. Bulletin 162.

*All screens available with patented Tension Wedge Outfit. Bulletin D-145.



Full-floating principle puts entire load on heavy-duty springs. Less horsepower needed. No live load impact on drive shaft or bearings. No escaping vibration; no damage to supports. Many models and styles available, including self-discharging. From 250 lbs capacity to 100 tons capacity. Bulletin 124C.

Reduce from hours to minutes time required to unload bottom dump rail cars. Two main types available: overhead units for heavy-duty or general service to unload as few as two cars a day. Trackside car shakeout: single unit is designed to unload from one car per week to 8 cars/day. Handles covered cars, too. All types push-button-controlled for SAFETY. Require only one operator. Bulletins 163 and 172.

We offer all types: woven wire cloth: high tonnages, accurate sizing made possible by precision weaving and metallurgical control. Wide variety of sizes, weaves, and materials... Non-woven preparations: perforated plate in wide variety of materials. Stainless steel profile wire decks of integral panel construction. Rod decks of exclusive "Cog-rod" (snap-in) construction or "Loose-rod" construction. Grizzly decks with exclusive Vari-grid (movable-bar) design, with cast manganese bars. Immediate shipment from stock on many specifications.

WRITE FOR TECHNICAL BULLETINS.

Complete descriptive and application data available. Write today!



Conveyor Machinery and Belting • Power Transmission Hose • Vibrating Equipment • Engineering Services

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WHAT IS YOUR BEST BUY IN **REUSABLE HOSE FITTINGS?**



- Minimum envelope dimension
- No special tools required for assembly or disassembly
- Uses standard hose
- & Complete reusability
- Pressure rating equal to burst of hose
- Uniform compression

SLEEVE AND SEGMENTED TYPE



Wire exposed to corrosion . Limited reusability of segments . Large envelope dimension • Special tools and/or equipment required for assembly and disassembly . Non-uniform compression . Limited service history

CLAMP TYPE



Doesn't grip wire . Limited pressure rating Large envelope dimension * Non-uniform compression * End of hose exposed to corresion

NON-SKIVE TYPE



High assembly torques * Inconsistent grip of wire * Uses non-standard thin cov-ered hose which has critical tolerances . Special tools required for proper assembly of hose to socket

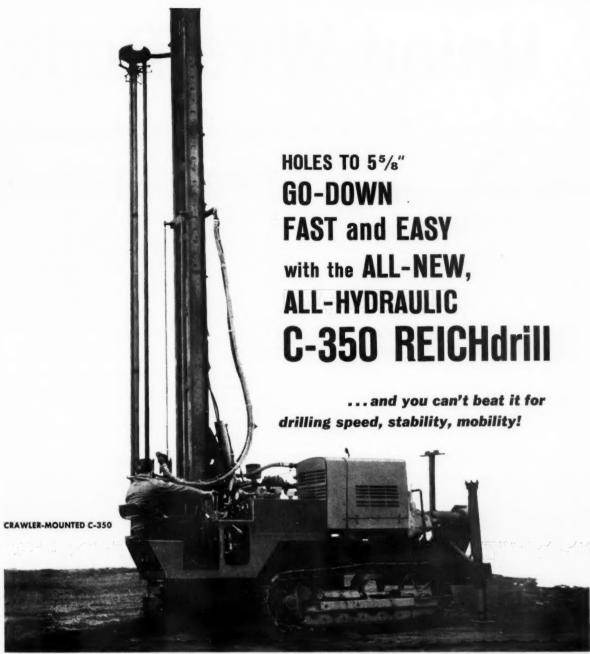
SF5-1



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For complete information, write for Stratoflex Catalog 201.



NOMINAL HOLE SIZE—17%" to 55%" • DOWN PRESSURE—10,000 LBS. • ROTARY SPEED to 540 RPM

Easy Operation is assured by all-hydraulic, labor-saving controls. Stability is provided by 14" wide tracks, low center of gravity and 8'8" wide frame plus 3 REICH heavy-duty hydraulic leveling jacks. Mobility is high because the crawler-mounted 350 trams at 7.8 MPH; climbs 25% grades, turns in its own length. Versatility is basic in REICHdrill design. The 350 is at home blastholing with 3-cone rotary bits, In-Hole Drills, ordrag bits; and whether coring or prospecting.

A truck-mounted T-350 REICHdrill for greater mobility with all the above advantages, is also available. Get detailed specifications.

Ask for SP-5001-2

PRANELIN (VENANGO COUNTY), PENNA.
Division: CHICAGO PNEUMATIC TOOL CO.

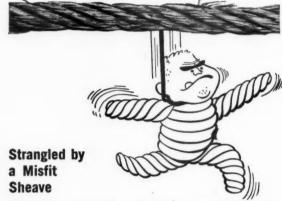


Union Wire Rope

In Union, There Is Quality That Responds



The rated capacity of a wire rope is based on the breaking strength (catalog) divided by a safety factor applicable to the type of service or use. The grade of steel, type of construction and size of the rope determine tensile strength. It must be properly related to the loads it will carry, or costly and dangerous early failures are likely to occur.



When the groove of a sheave is too small for the rope diameter, pinching action quickly destroys the rope—especially when it's overloaded. The victim shown here was knocked out in just 1½ hours of service.

UNION Wire Rope Tuffys—Famed For Tough Job Performance



Tuffy Scraper Rope
Flexible enough to take sharp bends; stiff enough to resist looping and kinking when slack; highly resistant to the shock of load impact — that's Tuffy balanced construction. Mount a reel on your scraper—save wasting sound rope.





Tuffy Slings and Hoist Lines
Slings are a patented, 9-part machine-braided wire fabric that is
next to impossible to knot or kink.
Hoist lines have built-in strength,
toughness, flexibility. Balanced—a
top-performing team for handling
every type of material. In addition
to Tuffy, Union Wire Rope furnishes a complete line of slings.





Tuffy Dozer Rope

Mounts right on your dozer in a 150' reel. When rope shows wear, just feed through enough to replace the damaged part. Saves rope, gives you a bonus of extra service. Also available in 300' and 500' reels.

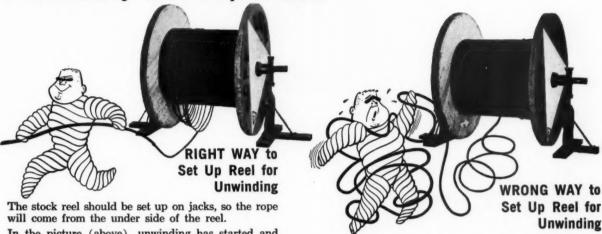


Union Knows the Ropes—Comes Up With Solutions To Wire Rope Problems And we have 'em—more than 1600 standard constructions. Add to that the famous Tuffy family of special ropes and slings, custom-made for special needs and special uses. If none of these fit your needs, our research laboratory engineers and field staff are at your service. They'll build you just the rope or sling you need—with Union toughness and Union quality all the way. Ask your Union distributor—listed in the phone book Yellow Pages.

Tuffy Tips



Profitably To Proper Use



In the picture (above), unwinding has started and the reel is turning faster than the rope is being pulled off. But no damage is done. Why? Because in coming from the under side of the reel, the rope is simply loosening, without forming loops or kinks.

The rope is coming from the top of the reel and forming loops as it overruns. These loops are likely to form kinks and dog legs, which can be ruinous to rope life.



Tuffy Dragline Rope

High abrasive resistance and super flexibility. Gives long service, dependable action in handling any material—wet or dry dirt, sand, gravel, rock, minerals. Rides smoothly on grooves—hugs the drum when casting for full load.

Union Wire Rope Handbook of TUFFY TIPS...Free!

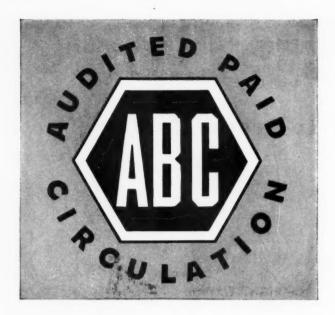
The "Tuffy Tips" shown here are quoted right out of Union's handbook. In it there are dozens of other priceless hints on the correct use of wire rope. The common abuses and how to avoid them. How to save costly injuries. Maintenance tips. The proper fittings and how to apply them. Recommended sizes. Many other facts and suggestions that will cut down your rope costs and help you get out of wire rope the full service we build into it. No charge. Write Union Wire Rope, Armco Steel Corporation, 2144 Manchester Ave., Kansas City 26, Missouri.



3-61



ARMCO Union Wire Rope



The Hallmark of Circulation Value

Three thousand eight hundred and eighty-four advertiser, agency and publisher members of the Audit Bureau of Circulations have a voice in establishing and maintaining the standards responsible for the recognition of this emblem as the Hallmark of Circulation Value. It represents the standard of value that these buyers and sellers of advertising space have jointly established as measure-

ment for the circulation of printed media.

The basis for arriving at the advertising value of a publication is the Bureau's single definition of net paid circulation. With this as the standard, the circulation records of A.B.C. publisher members are audited by experienced circulation auditors. As specified in the Bureau's Bylaws, A.B.C. auditors have "access to all books and records."

Subscription and renewal orders, payments from subscribers, paper purchases, postal receipts, arrears are among the publisher's circulation records that are painstakingly checked by auditors and the resulting data are condensed and published in A.B.C. Reports.

Experienced space buyers use the audited information in A.B.C. Reports as a factual basis for their decisions in evaluating, comparing and selecting media. The FACTS in A.B.C. Reports for business publications

include: • How much paid circulation
• How much unpaid distribution • Occupational or business breakdown of subscribers • Where they are located
• How much subscribers pay • Whether or not premiums are used • How many subscribers in arrears • What percentage of subscribers renew.

This publication is a member of the Audit Bureau of Circulations and is proud to display the Hallmark of Circulation Value as the emblem of our cooperation with advertisers. Ask for a copy of our A.B.C. Report and then study it.

Paid subscriptions and renewals, as defined by A.B.C. standards, indicate an audience that has responded to a publication's editorial appeal. With the interests

SEND THE RIGHT MESSAGE

TO THE RIGHT PEOPLE

appeal. With the interests of readers thus identified, it becomes possible to reach specialized groups effectively with specialized advertising appeals.



MINING CONGRESS JOURNAL

A.B.C. REPORTS — FACTS AS A BASIC MEASURE OF ADVERTISING VALUE

HOIST PROFITS

with STRAIGHT-LINE ORE PRODUCTION



ROCKOVER SKIP SYSTEMS

"The shortest distance between two points is a straight line". this applied to ore production, means greater tonnage at lower costs, 200KOVER SKIP SYSTEMS... the "straight-line" method ... elevate materials by the shortest, fastest and most economical method from all howers.

By eliminating costly roads, long hauls, and with only a minimum of personnel, the ROCKOVER SKIP SYSTEMS have the lowest operating and maintenance costs... are floatible to follow pit bottom as operations go deeper... you actually dig deeper at reduced costs. No large invostment in parts and standby equipment is necessary.

Ruggedly built, ROCKOVER SKIP SYSTEMS had one or wants at any time...are available in 15 to 50 ton capacities.

in use since 1949

Nico

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NATIONAL IRON COMPANY

50th Avenue West and Ramsey Street • Duluth 7, Minnesota

Subsidiary of Pettibone Mulliken Corporation, Chicago 51, Illinois

SCOOT-CRETE PAYLOAD ACTION! FOR ECONOMICAL MINING EFFICIENCY!



Model CD-4T Scoot-Crete Ore Carrier in action. Notice side-mounted driver position for maximum vision forward and rear.

SCOOT-CRETE ore carriers are ruggedly built for durable performance in all size mines under the toughest conditions. That is why there are hundreds in use throughout the mining industry. Diesel-powered for operation inside the mine, SCOOT-CRETE carriers give around-the-clock service; carry up to 15 tons at speeds to 15 mph, climb grades up to 18%. Production goes up, costs come down with SCOOT-CRETE payload action!

Models CD-3N and CD-4T

HEAVY-DUTY TRANSMISSION — 4 SPEEDS FORWARD, 4
 REVERSE ● 4-WHEEL BRAKES; AIR OVER HYDRAULIC ● 12"
 DRY DISC TRACTOR CLUTCH ● 75 HP DIESEL ENGINE

Model KD-5

AUTOMATIC TRANSMISSION — 3 SPEEDS FORWARD, 3
 REVERSE ● AIR COOLED DIESEL ENGINE ● POWER HYDRAULIC STEERING ● AIR BRAKES

ALL CD MODELS APPROVED BY U.S. BUREAU
OF MINES FOR UNDERGROUND MINING

Write for Additional Specifications and Literature SEE YOUR DEALER SOON!

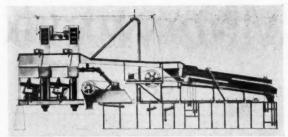


Model KD-5 — 15 Ton Payload



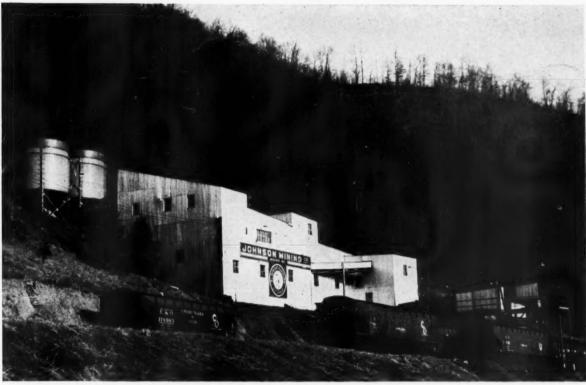
Model CD-3N - 5 Ton Payload

GETMAN BROTHERS . SOUTH HAVEN 15, MICHIGAN



Above - Unit Washer with two compartment Diaphragm Jig, dewatering and sizing screen, clarification tank with recovery conveyor and water circulating system. (Patented)

"Here's how Jeffrey helps us maintain our high uniformity"



Coal is effectively dewatered and accurately sized by the Jeffrey system, producing a product that is uniformly high in quality. Equipment furnished by Persinger Supply Company, Williamson, West Virginia, an authorized Jeffrey Distributor.

"Our Jeffrey-equipped plant produces 3,000 tons per day of the high quality coal demanded by our steam and metallurgical coal customers", says Mr. Fon M. Johnson, President of Johnson Mining Company, Pikeville, Kentucky.

Coal from a pair of silos is proportioned to the plant by two Jeffrey vibrating feeders. After screening and reduction in a Jeffrey crusher, it is washed, cleaned, sized and dewatered in the Jeffrey equipment.

The Jeffrey Jig rejects clean refuse, allowing only a small loss of burnable material. Ash content is held to an average of 3%. Quality and uniformity are maintained, day after day.

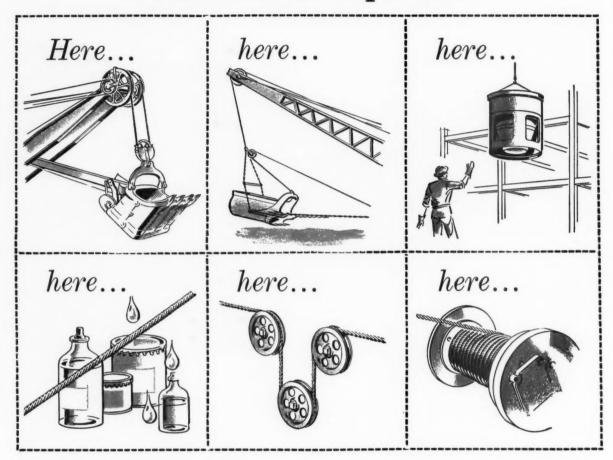
The Jeffrey Manufacturing Company, 958 North Fourth St., Columbus 16, Ohio.

If it's conveyed, processed or mined, it's a job for Jeffrey.



The right Macwhyte

reduces wire-rope wear



\dots and it cuts costs



Ask about Macwhyte's new 7-FLEX® wire rope

The right Macwhyte, PREformed and internally lubricated, gives you the combination of wearing qualities your equipment demands. Macwhyte has more than 60 years' experience in meeting the needs of open-pit and underground mining equipment . . .

Strippers **Loading Shovels Draglines** Shaft Sinking

Incline Hoists **Shaft Hoists** Blast-hole Drills Scraper Loaders

Underground Scrapers Wagons Loaders Mining Machines

Conveyors Car Pullers Tuggers Slushers

Macwhyte distributors will give you the right Macwhyte. Circular 6025 tells why you save with the right wire rope on your equipment. It's free upon request to Macwhyte Company, 2900 Fourteenth Avenue, Kenosha, Wisconsin (or authorized distributor).

MACWHYTE Wire Prope COMPANY

Wire Rope Manufacturing U Specialists Since 1896

Let a Bethlehem engineer show you what roof bolts can do

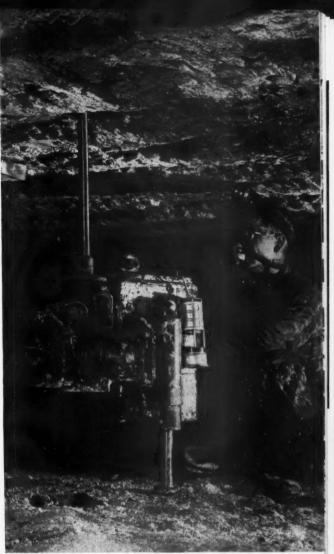




Economy Versatility







This Bethlehem roof bolt engineer is drilling to make a test installation in a coal mine. Besides increasing protection against rock fall, Bethlehem roof bolts will also assure maximum headroom and haulageway clearances.

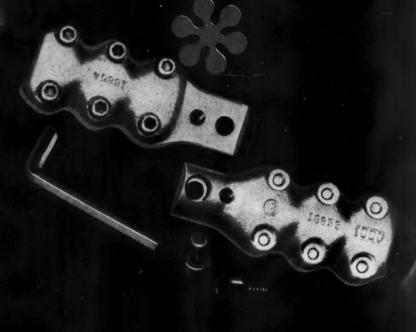
Bethlehem roof bolts minimize the danger of roof falls because they grip the strata, with the great strength of steel, to keep roof and walls in place.

A Bethlehem engineer will consult with you, without obligation. He will make tests in the strata to determine whether the rock lends itself to bolting. And he'll help to get your bolting crews started properly.

For the full story, get in touch with the nearest Bethlehem sales office. Or write to us at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. Export Sales: Bethlehem Steel Export Corporation

O-B Designs for Mining Men:



RESULT: you can make connections

aluminum cables... joining the same or different sizes ... either copper or aluminum



FAST...The new O-B Cable Connector makes or breaks a cable connection simply with the turning of two cap screws. These sturdy fittings are especially designed for sections that are picked up and moved frequently.

VERSATILE... You can add or remove sections of cable to keep pace with fast machinery. You can make tap-offs, 3-way connections between cables, or a variety of switch and panel arrangements...all in minutes!

 $\begin{tabular}{ll} \textbf{SIMPLE} \dots \textbf{Your O-B Cable Connectors give you the advantages of "built-in" cable connections that hook-up or disconnect simply. No specialist needed . . . saves time and labor on the job. \\ \end{tabular}$

Write us...or see your local O-B sales-engineer to order the new O-B Cable Connectors. You'll find—as others have—that they make moving easier, faster, and considerably cheaper. Ohio Brass Company—Mansfield, Ohio, Canadian Ohio Brass Company, Ltd., Niagara Falls, Ontario.

Ohio Brass B HOLAN

10050-M



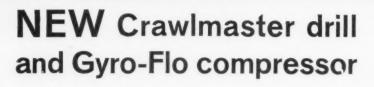
has earned customer

acceptance Consistent uniformity, right down to the core, is a big reason why more than a million tons of Sheffield Grinding Balls have been used in every kind of grinding job, around the world. They're uniformly hard, uniformly tough, with a uniformly dense grain structure

throughout. That's why Moly-Cop Balls keep their sphericity longer, give a better grind at a lower cost per ton. It's the result of Sheffield's constant quality control in alloying, forging and heat-treating. Sheffield Division, Armco Steel Corporation, Sheffield Station, Kansas City 25, Mo.

SHEFFIELD MOLY-COP Grinding Balls





...most versatile and powerful combination available for 4" to 6½" blast holes

THE INGERSOLL-RAND CRAWLMASTER is a multi-purpose blasthole rig with extra weight and power for the toughest drilling jobs. This rugged machine is mounted on dozer-type crawlers with enclosed gear drive from two 11½-hp air motors, and interchangeable drill units permit percussion, rotary or Downhole drilling of 4" to 6½" holes at any angle from vertical to horizontai. Features include hydraulic feed and retraction, remote controlled reverse rotation, 30" hydraulic leveling jacks and simple ejector-type dust collector.

Ample air power for all Drillmaster functions is provided by a 900-cfm Gyro-Flo rotary compressor—the last word in portable compressor economy and dependability. Simplicity of operation, freedom from maintenance, small size and light weight, air temperatures under 200°F, low oil consumption and closer regulation at all loads make Gyro-Flo the ideal running mate for the new

Crawlmaster drill.

Ask your I-R distributor or engineer for complete information on the cost-saving Crawlmaster Gyro-Flo combination.



Ingersoll-Rand

A CONSTANT STANDARD OF QUALITY IN EVERYTHING
YOU NEED FOR DRILLING ROCK

1961 AMC MINING CONVENTION

Matters of Prime Importance to All Branches of Mining will be Discussed at Mining Congress Meeting in Queen City of the Northwest, September 10-13.

HE EYES OF THE MINING INDUSTRY will be focused on the Pacific Northwest in mid-September as Seattle plays host to the 1961 Metal Mining and Industrial Minerals Convention of the American Mining Congress. The current domestic and world situation, the stepped-up defense program and other measures to meet a possible emergency, and the many advances being made in the technology of mineral exploration, extraction and processing which will be reviewed and discussed, combine to make this meeting one of extraordinary importance to mining men. Add to this the many scenic attractions of the Seattle area, and it is easy to see why mining men and ladies from across the Nation are planning to return to the scene of the highly successful 1953 meeting.

Leaders in Government will be on hand to express their views on national mineral policies, top level mining officials will discuss the state of the mineral industries, and highly qualified mining men will report on technical and operating developments in all phases of this great industry.

Convention arrangements have been made under the leadership of AMC Western Division Chairman Robert M. Hardy, Jr., President, Sunshine Mining Co., and Arrangements Committee Co-Chairman S. M. Strohecker, Jr., Seattle Manager of E. I. du Pont de Nemours & Co., Inc. An

industry wide Program Committee working with Committee Chairman Joseph C. Kieffer, Manager of the Northwestern Mining Department of the American Smelting & Refining Co., has organized 20 general and operating sessions and lined up an outstanding series of addresses.

Busy Days

The general sessions will include talks on National Mineral Policies; Labor Relations; Public Lands; Gold, Silver and Monetary Policies; the State of the Mining Industries, and a Conference on the Future of Uranium. A tax panel and an all-day tax forum will have special appeal to all those interested in mining tax matters. Operating sessions will cover Exploration and Geology, Milling and Metallurgy, Safety and Health, Open Pit Mining, Underground Mining, Management Tools

and Techniques, and General Operating Problems. There will also be a symposium on the everimportant subject of Maintenance. For complete information on the program, turn to page 40.

In order to give public expression to the mining industry's views on national policies, a "Declaration of Policy" dealing with major problems of the day will be prepared by a Resolutions Committee composed of leaders in all branches of the mining industry, and will be presented for consideration by the Convention. Twelve subcommittees have been drafting the various "planks" of the Declaration, and these will be reviewed by the full Committee in Seattle preceding the meeting. The Committee will welcome suggestions from all interested mining men; these should be submitted to the chairman, Kenneth C. Kellar, Chief Counsel, Homestake Mining Co., Lead, S.D., with copy

to the American Mining Congress, Ring Building. Washington 6. D.C.

Fun-Filled Hours

On the lighter side, several special events have been planned for the benefit of Convention goers. The traditional reception and cocktail party for mining men and their ladies, to be held at the Olympic Hotel on Sunday afternoon, September 10, will set the stage for a week of good fellowship always in evidence at Mining Congress meetings. On Monday evening the Miner's Jamboree, which this year takes the form of a "Potlatch" celebration, will be held at the National Guard Armory. Barbecued Quinault salmon, famous the world over as a gourmet's delight, will be served at dinner, followed by a specially arranged program of entertainment and dancing.

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- Copper Co.
 CHARLES F. WILLIS, State Secy., Arizona Small Mine **Operators Association**

Early rising fishermen, and fisherwomen too, will have an opportunity to catch some of Puget Sound's big salmon during the Salmon Derby on both Tuesday and Wednesday mornings. Transportation, boats and fishing gear will be provided—and a prize awaits the person catching the largest fish.

The Convention will wind up Wednesday evening with a "Speechless" banquet. Following a fine dinner, U. S. Senator Alan Bible of Nevada will briefly introduce the head-table guests before turning the spotlight to another gala entertainment program. Arthur Lee Simpkins, who first charmed a Mining Congress audience eight years ago, will be the star of this program. The world-famous tenor has delighted audiences from coast to coast and in the capitals of the Continent, and his appearance will make this a long-remembered occasion.

Ladies Program

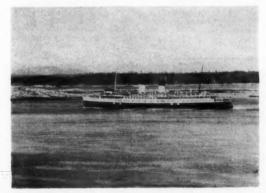
Ladies are cordially invited to take part in all Convention activities, and a special invitation is out for them to attend the two daytime events that have been planned for their enjoyment by the Ladies Committee under the chairmanship of Mrs. Robert M. Hardy, Jr.

At a Flower Arrangement Luncheon on Tuesday, James Crissy, nationally known florist and designer, will demonstrate his techniques in producing artistic floral pieces. A number of these will be presented as door prizes.

A Brunch and Sightseeing Boat Trip will occupy the attention of the ladies on Wednesday. A mid-morning brunch at the Wharf restaurant on Seattle's picturesque waterfront will be followed by a scenic cruise of Lake Washington Canal, Lake Union and Lake Washington and a drive through the city's beautiful Arboretum and some of its fine residential areas.

Interest-Packed Trips

On the day following the Convention, Thursday, September 14, four interesting trips are



Many mining men and ladies will climax the convention with a cruise to Victoria on Thursday





planned for the pleasure of mining men and their ladies. An all-day trip to Victoria, the capital of British Columbia, will include a relaxing voyage up beautiful Puget Sound, a lunch at the famed Empress Hotel, a sight-seeing trip and an opportunity for shopping.

Another all-day trip will be made to spectacular Mount Rainier National Park, which in September will see snow at high elevations and autumn foliage at its best. Lunch will be served at Longmire Inn on the south slope of Mt. Rainier.

A tour of Bethlehem Steel's Seattle plant—recently expanded and improved at a cost of \$25,000,000—will be of interest to many. The tour will consist of a briefing on the plant's operation and an inspection of its facilities, including the electric-arc furnaces, baghouse, soaking pits, blooming and bar mills, and fabricating shop.

Still another group will wish to visit Boeing Airplane Company's Transport Division plant at Renton, where they will see the gigantic 707 Jet Liner and the smaller 727's and 720's under production. Visitors will also see an interesting motion picture on the Transport Division's operations.

Plan to Attend

The 1961 AMC Mining Convention offers the mining man an unparalleled opportunity to learn what's going on in his industry.

The program will cover matters of the utmost importance both to management and top production and technicalmen—matters that bear not only on the industry's progress but on the future of the country as well. Mining companies will serve themselves and their Nation by making the Convention a "must" meeting for everyone who can be spared.

Good accommodations are still available and requests for hotel or motel reservations should be made immediately—stating arrival and departure dates—by letter or telegram to the AMC Housing Bureau, Seattle Convention Bureau, 215 Columbia Street, Seattle 4, Washington.





ROBERT M. HARDY, JR. General Chairman



S. M. STROHECKER, JR. Co-Chairman

arrangements committees



M. H. FREEDMAN Chairman

WELCOMING -

RALPH WINSHIP S. C. BACON Vice-Chairmen

PUBLICITY



DAVID G. WOOD Chairman

"POTLATCH"





D. L. ANDERSON H. F. YANCEY Co-Chairmen

TRIPS



W. M. HEMPHILL Chairman

SALMON DERBY



E. G. EASTERLY Chairman

- LADIES -





MRS. R. M. HARDY MRS. R. M. HARDY, JR. MRS. W. E. ROMIG Honorary Chairman Co-Chairmen



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program committee







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CLAUDE O. DALE Mo.-Kans.-Okla.



JOHN BLEY Montana



ROBERT O. JONES



EARL H. MILLER New Mexico



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J. P. O'KEEFE Utah



JOHN W. CURRIE Washington



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L. J. RANDALL



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ELLERY SEDGEWICK, JR.



ALBERT E. SEEP



MERRILL E. SHOUP



HARRIE S. TAYLOR



ROBERT P. TIBOLT



THOMAS M. WARE



CLYDE E. WEED



S. H. WILLISTON



HOWARD I. YOUNG

All Convention functions will be held at the Olympic Hotel except as noted.

Spanish Ballroom

9:25 A.M. Pre-Session Motion Picture
"Washington—State of Wonderland"

9:45 A.M. NATIONAL MINERAL POLICIES

Opening of Convention

RAYMOND E. SALVATI, President, American Mining Congress

Presentation of Colors

Color Guard, Boy Scouts of America

Chairman: Hon. WARREN G. MAGNUSON, U. S. Senator from Washington

The Administration's National Mineral Policies

Hon. John M. Kelly, Assistant Secretary for Mineral Resources, Department of the Interior

Capitol Hill's Views As To Our Mineral Policies

Hon. Henry C. Dworshak, U. S. Senator from Idaho

Hon. Walter Rogers, U. S. Representative from Texas

Resolutions Committee Reports

General Policy National Mineral Policies Solid Fuels



ALBERT D. ROSELLINI Governor of Washington



HENRY M. JACKSON Senator from Washington



GORDON S. CLINTON Mayor of Seattle



THOMAS B. NOLAN
Director,
U. S. Geological Survey



WARREN G. MAGNUSON Senator from Washington



HENRY C. DWORSHAK Senator from Idaho



WALTER ROGERS Congressman from Texas



JOHN M. KELLY Assistant Secretary of Interior

12:15 P.M. WELCOMING LUNCHEON

Grand Ballroom

Presiding: ROBERT M. HARDY, JR., Pres., Sunshine Mining Co., Spokane; Chairman, Western Division, American Mining Congress

Invocation

THE REVEREND MARTIN L. GOSLIN, D.D., Plymouth Congregational Church, Seattle

Welcome to Washington

Hon. Albert D. Rosellini, Governor of Washington

Welcome to Seattle

Hon. Gordon S. Clinton, Mayor of Seattle

Responses

RAYMOND E. SALVATI, Chairman of Board, Island Creek Coal Co., Huntington, W. Va.; President, American Mining Congress

J. C. KIEFFER, Mgr., Northwestern Mining Dept., American Smelting & Refining Co., Wallace, Idaho; National Chairman, Program Committee

D. E. Davidson, Vice Pres., Link-Belt Co., Chicago; Chairman, AMC Manufacturers Division

JESSE F. CORE, Vice Pres.-Operations-Coal, U. S. Steel Corp., Pittsburgh; Chairman, AMC Coal Division

Introduction of Distinguished Guests

Address: Hon. Henry M. Jackson, U. S. Senator from Washington

Spanish Ballroom

1:40 P.M. Pre-Session Motion Picture "Faces and Fortunes" (Story of Corporate Communications)

2:00 P.M. LABOR RELATIONS

Chairman: J. C. Kieffer, Mgr., Northwestern Mining Dept., American Smelting & Refining Co., Wallace, Idaho

A Look At Our Labor Laws

Hon. Graham Barden, New Bern, N. C.; former U. S. Representative from North Carolina, and former Chairman, House Education and Labor Committee

Effect of Foreign Competition on American Industry and Labor

Hon. John H. Dent, U. S. Representative from Pennsylvania; Chairman, House Labor Sub-committee on Impact of Imports and Exports on American Employment

Labor Management Relations

(Speaker to be announced)

Resolutions Committee Reports

Labor Relations and Labor Legislation Mine Safety

Olympic Bowl

1:40 P.M. Pre-Session Motion Picture "Secrets of the Ice" (The Science of Glaciology Unlocks Man's Past)

2:00 P.M. EXPLORATION AND GEOLOGY

Chairman: EARL F. COOK, Dean, College of Mines, University of Idaho, Moscow

Vice Chairman: Peter Joralemon, Consulting Geol., San Francisco

Importance of Research in Creating Mineral Resources

THOMAS B. Nolan, Director, U. S. Geological Survey, Washington, D. C.

Geological Developments in the Twin Buttes District Near Tucson

WILLARD C. LACY, Professor of Geology, University of Arizona, Tucson

Extending Reserves in the Coeur d'Alene District ROLLIN FARMIN, Mgr. of Mines, and GARTH M. CROSBY, Chief Geol., Day Mines, Inc., Wallace,

Exploration Programs for Iron Ore, Lead, and Other Minerals in Missouri

THOMAS R. BEVERIDGE, State Geologist, Missouri Geological Survey, Rolla

Exploration at the Rio Blanco Project of Cerro Corp.

Frank N. Spencer, Jr., Mgr., Mining & Explora-tion Div., Cerro Corp., New York



JOHN H. DENT Congressman from Pennsylvania



GRAHAM BARDEN Former Congressman from North Carolina

Georgian Room

1:40 P.M. Pre-Session Motion Picture "Refining Precious Metals from the Sudbury Nickel Ores"

2:00 P.M. MILLING AND METALLURGY

Chairman: J. C. KINNEAR, JR., Gen. Mgr., Nevada Mines Div., Kennecott Copper Corp., McGill, Nev.

Vice Chairman: CHARLES H. CURTIS, Asst. Resident Mgr., Copper Div., Duval Sulphur & Potash Co., Tucson, Ariz.

Trends in Mineral Processing Research

ROBERT J. BRISON, Asst. Chief, Materials Beneficiation Div., Battelle Memorial Institute, Columbus, Ohio

Automation in the Copper Queen Mill

PHILIP F. ALLEN, Mill Supt., Phelps Dodge Corp., Bisbee, Ariz.

Application of X-Ray Emission to On Line Control in the Mining Industry

W. F. LORANGER, Mgr., Chemical Process Sales, and Rolf G. Edholm, Mgr., Product Planning-Industrial, General Electric Co., Milwaukee

Advances in Copper Concentration Techniques

E. P. CADWELL, Chief Metallurgist, Mining Chemicals Dept., American Cyanamid Co., New York

Heavy Media Cyclones in Iron Ore Beneficiation

WILLIAM R. VAN SLYKE, Range Metallurgist, Cleveland-Cliffs Iron Co., Taconite, Minn.

7:00 P.M. "POTLATCH" CELEBRATION

National Guard Armory

Buses leave downtown hotels beginning at 6:30 P.M.

Tuesday, September 12

Spanish Ballroom

9:10 A.M. Pre-Session Motion Picture
"Alaska"

9:30 A.M. PUBLIC LANDS

Chairman: Hon. Wayne N. Aspinall, U. S. Representative from Colorado; Chairman, House Interior and Insular Affairs Committee

Our Public Lands Policies

Hon, John A. Carver, Jr., Assistant Secretary for Public Land Management, Department of the Interior

What Constitutes a "Valid Discovery" Under the Mining Laws

Hon. Karl S. Landstrom, Director, Bureau of Land Management

Discussion: Howard A. Twitty, Attorney, Phoenix, Ariz.

Pending "Wilderness" Legislation

W. Howard Gray, Attorney, Reno, Nev.; Chairman, AMC Public Lands Committee
Hon. Lee Metcalf, U. S. Senator from Montana

The Need for Exploration Claims

G. H. LADENDORFF, Attorney, Phoenix, Ariz.

Resolutions Committee Reports

Public Land Policy Water and Air Pollution

Olympic Bowl

9:10 A.M. Pre-Session Motion Picture
"Charlie's Haunt" (Community
Safety Consciousness)

9:30 A.M. SAFETY AND HEALTH

Chairman: Frank Coolbaugh, Pres., American Metal Climax, Inc., New York

Uranium Operators Safety Council in the Grants

John Abbiss, Safety Dir., Homestake-Sapin Partners, Grants, N. M.

Use of Incentive Awards for Safety

HERBERT A. WENDEL, Chairman, Bureau of Safety, The Anaconda Company, Butte, Mont.

Safety Program of Bethlehem Steel Co.

F. R. BARNAKO, Mgr., Compensation and Safety Dept., Bethlehem Steel Co., Bethlehem, Pa.

Hidden Costs of Accidents

G. M. Hostetter, Supervisor of Safety, Erie Mining Co., Hoyt Lake, Minn.

Job Hazard Analysis

P. Morgan Wadsworth, Safety Dir., Climax Molybdenum Co., Climax, Colo.



LEE METCALF Senator from Montana



WAYNE N. ASPINALL Congressman from



JOHN A. CARVER Assistant Secretary of Interior



KARL S. LANDSTROM Director, Bureau of Land Management

Georgian Room

9:10 A.M. Pre-Session Motion Picture
"Blasting Vibrations—Cause
and Effect"

9:30 A.M. OPEN PIT MINING

Chairman: Carl G. Hogberg, Pres., Michigan Limestone Div., U. S. Steel Corp., Detroit

Vice Chairman: O. E. Pothier, Dir. of Mining Operations, J. R. Simplot Co., Pocatello, Idaho

Effect of Fragmentation on Crusher Performance JAMES CARR, Asst. Mine Supt., National Lead Co., Tahawus, N. Y.

New Techniques in Silica Sand Production

Hugh H. Bein, Mgr., Sand Div., Del Monte
Properties Co., Pebble Beach, Calif.

Recent Developments in Open Pit Haulage

E. R. Borcherdt, Partner, Borcherdt & Smith,
San Francisco

Use of a Digital Computer in Calculating the Economic Limits of an Open Pit Mine Expansion JAMES F. OLK, Mine Supt., Pima Mining Co., Tucson, Ariz.

Open Pit Methods at the Craigmont Mine ROBERT HALLBAUER, Mine Supt., Craigmont Mine Ltd., Merritt, B. C.



CECIL R. KING Congressman from California



VICTOR A. KNOX Congressman from Michigan



ELLSWORTH C. ALVORD Attorney Alvord & Alvord

Spanish Ballroom

1:40 P.M. Pre-Session Motion Picture
"Time and Space" (Launching of
the Pioneer IV Rocket)

2:00 P.M. TAX PANEL

Chairman: L. J. RANDALL, Pres., Hecla Mining Co., Wallace, Idaho

HON. VICTOR A. KNOX, U. S. Representative from Michigan

HON. CECIL R. KING, U. S. Representative from California

ELLSWORTH C. ALVORD, Attorney, Alvord & Alvord, Washington, D. C.; Tax Counsel, American Mining Congress

Resolutions Committee Report

Taxation and Government Expenditures

GOLD, SILVER AND MONETARY 3:00 P.M. POLICIES

Co-Chairmen:

Donald H. McLaughlin, Chairman of Board, Homestake Mining Co., San Francisco; Chair-man, AMC Gold Producers Committee

ROBERT M. HARDY, Jr., Pres., Sunshine Mining Co., Spokane

Our Monetary Crisis

Percy L. Greaves, Jr., Economist, Dobbs Ferry, N. Y.

Silver's Position Today

DONALD B. MACCURDA, Partner, F. S. Smithers & Co., New York

Resolutions Committee Report

Gold, Silver and Monetary Policies

Olympic Bowl

1:40 P.M. Pre-Session Motion Picture 'Out of the Earth" (Story of Nonmetallic Minerals)

2:00 P.M. UNDERGROUND MINING

Co-Chairmen:

A. R. Patterson, Vice Pres. & Gen. Mgr., Knob Hill Mines Co., Republic, Wash.
A. B. Bowman, Vice Pres. & Gen. Mgr., Banner Mining Co., Tucson, Ariz.

Ground Water Control at Grace Mine

G. K. BIEMESDERFER, Geol., and R. H. LESKE. Mining Engr., Grace Mine, Bethlehem Steel Co., Bethlehem, Pa.

New Automatic Friction Mine Hoist

CARL W. Anderson, Asst. to Chief Engr., The Hanna Mining Co., Cleveland

Raise Driving at Anaconda

LEONARD P. COLVIN, Asst. Research Engr., and JOHN SUTTIE, Mine Supt., The Anaconda Com-pany, Butte, Mont.

Wire Rope Spooling: Method and Practices

L. D. THOMPSON, Chief Service Engr., Lebus International Engineers, Inc., Longview, Tex.

Special Cast Alloys for Underground Use

WILLIAM BARBER, JR., Mgr., Metallurgical Dept., Esco Corp., Portland, Oreg.

Georgian Room

1:40 P.M. Pre-Session Motion Picture 'Packaged Power" (Expansion of Aluminum Production)

2:00 P.M. MILLING AND METALLURGY

Chairman: ROBERT J. LINNEY, Pres., Reserve Mining Co., Silver Bay, Minn.

Grate-Kiln Pelletizing Process at Humboldt

ROBERT W. BERKHAHN, Operating Metallurgist, and DANIEL M. URICH, Pyrometallurgist, Cleveland-Cliffs Iron Co., Ishpeming, Mich.

Direct Reduction by the H-Iron Process

RUSSELL J. MacMullan, Vice Pres., and C. A. Johnson, Hydrocarbon Research Inc., New York

Columbia-Geneva's New Ore Testing Laboratory

MILTON F. WILLIAMS, Mgr., Raw Materials Research Laboratory, Columbia-Geneva Steel Div., U. S. Steel Corp., Provo, Utah

Cement Manufacturing Processes-European versus American

ERIK VOLDBAEK, Supervisor of Kiln Operations, Oregon Portland Cement Co., Portland, Oreg.

Disposal of Metallurgical Wastes at Anaconda

Frank H. Day, Gen. Supt., Anaconda Reduction Dept., The Anaconda Company, Anaconda, Mont.

Wednesday, September 13

Spanish Ballroom

9:10 A.M. Pre-Session Motion Picture
"Horizon North" (Erie Mining Co.'s
Minnesota Operations)

9:30 A.M. STATE OF THE MINING INDUSTRIES

Chairman: R. L. McCANN, Pres., The New Jersey Zinc Co., New York

Copper—James Boyd, Pres., Copper Range Co., New York

Lead-Zinc—CLARK L. WILSON, Chairman, Emergency Lead-Zinc Committee, Washington, D. C.

Discussion: RICHARD A. YOUNG, Vice Pres., American Zinc, Lead & Smelting Co., St. Louis

Iron Ore—CARL B. JACOBS, Vice Pres., Raw Materials, Inland Steel Co., Chicago

Light Metals —WALTER L. RICE, Pres., Reynolds Mining Corp., Richmond, Va.

Solid Fuels — DAVID L. FRANCIS, Pres., Princess Coals, Inc., Huntington, W. Va.

Industrial Minerals—R. M. Foose, Chairman, Dept. of Earth Science, Stanford Research Institute, Palo Alto, Calif.

Strategic Minerals —S. H. WILLISTON, Exec. Vice Pres., Cordero Mining Co., Palo Alto, Calif.

Resolutions Committee Reports Government Reorganization Mine Financing Uranium

Georgian Room

9:10 A.M. Pre-Session Motion Picture
"Bridge to the Future" (Building of
the Glen Canyon Dam)

9:30 A.M. UNDERGROUND MINING

Chairman: M. F. Bolton, Vice Pres. & Gen. Mgr., Kermac Nuclear Fuels Corp., Grants, N. M.

Vice Chairman: EARL H. MILLER, Resident Mgr., U. S. Borax & Chemical Corp., Carlsbad, N. M.

Use of Ammonium Nitrate Explosives Underground

ROBERT P. MATSON, Mine Supt., Midwest Ore Co., Iron Mountain, Mo.

Underground Concreting Practices—Sullivan Mine A. G. Stirling, Operating Supt., Sullivan Mine, Consolidated Mining & Smelting Co. of Canada Ltd., Kimberly, B. C. Use of AC Shuttle Cars at Carlsbad

D. F. Parker, Maint. Supt., National Potash Co., Carlsbad, N. M.

New Trends in Underground Rail Loading and Tramming

James W. Clark, Mgr., Mining Machinery Div., Lake Shore, Inc., Iron Mountain, Mich.

Texas Gulf Sulphur Company's New Potash Project
DR. C. F. FOGARTY, Vice Pres., Texas Gulf Sulphur Co., New York, and Frank Tippie, Resident Mgr., Moab, Utah

Williamsburg Room

9:10 A.M. Pre-Session Motion Picture
"Concrete in the 60's"

9:30 A.M. MAINTENANCE SYMPOSIUM

Co-Chairmen:

Donald M. Chisholm, Assoc. Gen. Mgr., Lake Superior Mining Div., Pickands Mather & Co., Duluth, Minn.

EDWIN C. DEMOSS, Mgr., Iron and Coal Operations, Utah Construction & Mining Co., San Francisco

Preventive Maintenance Program at Weed Heights A. E. Millar, Gen. Mgr., The Anaconda Co., Weed Heights, Nev.

Use of Computers in Equipment Analysis
E. R. Drevdahl, Associate Prof. of Mining Engineering, University of Arizona, Tucson

Control of Materials and Supplies
O. C. Madsen, Div. Comptroller, Utah Copper Div,. Kennecott Copper Corp., Salt Lake City

Lubrication of Mining Machinery
ROBERT C. CUFFELL, Tech. Specialist, Standard
Oil Co. of California, Seattle

Plant Services Program at Bunker Hill Co. LeVern M. Griffith, Mgr., Plant Services, The Bunker Hill Co., Kellogg, Idaho

Rex Room

9:30 A.M. TAX FORUM

Chairman: Lincoln Arnold, Chairman, Tax Committee, American Mining Congress

Informal Discussion by accountants and others handling mining tax matters (continued in afternoon).

Spanish Ballroom

1:40 P.M. Pre-Session Motion Picture
"Project Echo" (Story of Space
Communications)

2:00 P.M. MANAGEMENT TOOLS AND TECHNIQUES

Chairman: Nelson C. White, Vice Pres., International Minerals & Chemical Corp., Skokie, Ill.

Vice Chairman: Benton Boyd, Asst. to Vice Pres., U. S. Smelting Refining & Mining Co., Salt Lake City

Industry's Position on Practical Politics

PATRICK J. HILLINGS, Regional Civic & Governmental Affairs Mgr., Ford Motor Co., Los Angeles

Management's Need for Research to Meet Competition

STANLEY D. MICHAELSON, Chief Engr., and STUART R. ZIMMERLEY, Dir., Kennecott Research Center, Western Mining Divs., Kennecott Copper Corp., Salt Lake City

Industrial Engineering and Research in Mining

R. M. Stewart, Dir., Mining Research, The Anaconda Company, Butte, Mont.

Role of the Psychologist in Management

ROBERT O. SHAFFER, Partner, Rohrer, Hibler & Replogle, Chicago

Systems Analysis Applications in the Mineral Industry

CLARKE K. OLSON, Mining Instructor, Michigan College of Mining & Technology, Houghton-

Georgian Room

1:40 P.M. Pre-Session Motion Picture
"Open Pit Mining of
Copper in the 60's"

2:00 P.M. OPEN PIT MINING

Chairman: J. B. Pullen, Asst. Gen. Mgr., Western Operations, Phelps Dodge Corp., Douglas, Ariz.

Vice Chairman: C. V. O. Hughes, Asst. Dept. Mgr., Mining Div., Virginia-Carolina Chemical Co., Nichols, Fla.

New Applications of Explosives

H. E. FARNAM, JR., Mgr. of Operations, Iron Ore Co. of Canada, Sept-Iles, Que.

Developments in Taconite Blasting at Erie F. D. BICKEL, Consulting Engr., Wilmington, Del.

The Atlantic City Story

A. S. Henderson, Process Development Engr., Columbia-Geneva Steel Div., U. S. Steel Corp., Lander, Wyo.

New Phosphate Operation Near Vernal, Utah

R. K. Barcus, Asst. Gen. Mgr., San Francisco Chemical Co., Montpelier, Idaho

Open Pit Mining of Rock Salt

ADOLPH V. MITTERER, Plant Mgr., California Salt Co., Amboy, Calif.



PATRICK J. HILLINGS Former Congressman from California



Wednesday, September 13 (continued)

Williamsburg Room

1:40 P.M. Pre-Session Motion Picture
"From Mountains to Microns"
(Drama of Portland Cement

2:00 P.M. GENERAL OPERATING DEVELOPMENTS

Chairman: THOMAS B. DOUGLAS, Vice Pres., Ideal Cement Co., Denver

Vice Chairman: Hercules C. Pappas, Exec. Staff Asst., Raw Materials Div., Aluminum Co. of America, Pittsburgh

Transportation of Solid Materials by Pipeline
EDMOND CHAPUS, SOGREAH, New York

Designing Mining Equipment for Human Operation

JOSEPH W. WULFECK and LAWRENCE R. ZEITLIN,
Dunlap & Associates, Inc., Santa Monica, Calif.

Cable Tramway Automation

CLYDE HOLEN, Plant Engr., Northwest Magnesite Co., Chewelah, Wash.

Panel on Grouting for Control of Ground Water

LIONEL A. YORK, Mining Engr., Cementation Co. of America, Inc., Toronto, Ont.

JOHN J. REED, Professor of Mining Engineering, Colorado School of Mines, Golden, Colo.

VICTOR L. STEVENS, Mgr., Mining Div., Boyles Bros. Drilling Co., Salt Lake City

G. J. FENIX, Fenix & Scissons, Inc., Wilmington, Del.



See you in Seattle!



WAYNE N. ASPINALL Congressman from Colorado



THOMAS B. UPCHURCH Atomic Energy Commission

Pacific-Evergreen Room

1:40 P.M. Pre-Session Motion Picture
"Production of Uranium Feed
Materials"

2:00 P.M. URANIUM CONFERENCE

What Will be the Status of the Uranium Mining Industry After 1966?—A Panel Discussion

Hon. WAYNE N. ASPINALL, U. S. Representative from Colorado; Chairman, House Interior and Insular Affairs Committee, and Chairman, Raw Materials Subcommittee, Joint Atomic Energy Committee

THOMAS B. UPCHURCH, Asst. Dir. for Procurement, Raw Materials Div., U. S. Atomic Energy Commission

Dr. Lyman R. Fink, Gen. Mgr., Atomic Products Div., General Electric Co., Palo Alto, Calif.

MITCHELL MELICH, Pres., Uranium Reduction Co., Moab, Utah

7:00 P.M. "SPEECHLESS" BANQUET

Spanish & Grand Ballrooms

Toastmaster: Hon. Alan Bible, U. S. Senator from Nevada

Introduction of Distinguished Guests

Special Entertainment



ALAN BIBLE Senator from Navada



American Mining Congress Manufacturers Division

Acme Machinery Co. Allegheny Ludlum Steel Corp.
Allen-Sherman-Hoff Pump Co.
Allis-Chalmers Manufacturing

Alloy Steel & Metals Co. American Air Filter Co., Inc. American Brattice Cloth Corp. American Chain & Cable Co. American Cyanamid Co.
American Manganese Steel Div.

American Brake Shoe Co. American Mine Door Co. Anaconda Wire & Cable Co. Atlas Copco, Inc. Atlas Chemical Industries, Inc.

Baldwin-Lima-Hamilton Corp. Construction Equipment Div. Barber-Greene Co.
Bearing Service Co.
Bethlehem Steel Co.
Bird Machine Co.
Bixby-Zimmer Engineering Co. Bowdil Co. Broderick & Bascom Rope Co. Brooks Oil Co. Brunner & Lay, Inc. Bucyrus-Erie Co.

C. & D. Batteries Div. The Electric Autolite Co. Card Iron Works Ce., C. S.
Caterpillar Tractor Co.
Central Mine Equipment Co.
Centrifugal & Mechanical
Industries, Inc. Chain Belt Co. Chicago Pneumatic Tool Co. Cincinnati Mine Machinery Co. Cities Service Petroleum, Inc.
Colorado Fuel & Iron Corp.
Columbus McKinnon Corp.
Connellsville Corp. Conners Stee Div.
H. K. Porter Co., Inc.
Continental Motors Corp.
Cross Perforated Metals Plant
National Standard Co.
Crucible Steel Co. of America
Cummins Engine Co., Inc.

Deister Concentrator Co., The Differential Steel Car Co. Dorr-Oliver Inc. Dow Chemical Co. Dravo Corp. Engineering Works Div.
* Du Pont de Nemours & Co., Inc., E. I.

Eastern Sales Co. Eimco Corp.
Electro-Technical Labs. Div. of Mandrel Industries, Inc. Electric Storage Battery Co.

* Charter Members

* Elreco Corp.
Ensign Electric & Manufacturing

Enterprise Wheel & Car Corp. Equipment Engineers, Inc. Esco Corp. Euclid Div., General Motors Corp.

Fairmont Machinery Co. Fairmont Machinery Co. Femco, Inc. Firestone Tire & Rubber Co. Firth Sterling, Inc. Flexible Steel Lacing Co. Flexible Tubing Corp. Flood City Brass & Electric Co. Gardner-Denver Co.

* General Electric Co. Getman Brothers Manufacturing

* Goodman Manufacturing Co. Goodrich Co., B. F.
Goodyear Tire & Rubber Co., Inc.
Gorman-Rupp Co.
Gould-National Batteries, Inc.
Gundlach Machine Co., T. J.
Div. of J. M. J. Industries, Inc. Guyan Machinery Co.

H. & L. Tooth Co. Harnischfeger Corp. Hendrick Manufacturing Co. Hendrix Manufacturing Co.

* Hercules Powder Co. Hewitt-Robins Heyl & Patterson, Inc. * Holmes Brothers, Inc.

Hoyt Wire Cloth Co. Hughes Tool Co. Hulburt Oil & Grease Co. Humphreys Engineering Co.

* I-T-E Circuit Breaker Co. Industrial Physics & Electronics Ingersoll-Rand Co.

International Harvester Co. International Nickel Co., Inc. Interstate Equipment Corp. Irwin-Sensenich Corp.

* Jeffrey Manufacturing Co. Johnson-March Corp. * Joy Manufacturing Co.

KW-Dart Truck Co. Kaiser Aluminum & Chemical Sales, Inc. Kansas City Structural Steel Co. Keliogg Co., M. W. Kennametal Inc. Kensington Steel Div. of Poor & Co. Koehler Manufacturing Co.

Lee-Norse Co. Le Roi Div., Westinghouse Air

Brake Co.

* Leschen Wire Rope Div.
H. K. Porter Co., Inc.
LeTourneau, Inc., R. G.
LeTourneau-Westinghouse Co. * Link-Belt Co.

Long-Airdox Co., a Div. of Marmon-Harrington Co., Inc. Longyear Co., E. J. Ludlow-Saylor Wire Cloth Co.

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THUNDERBIRD

By W. A. ENDICOTT General Superintendent Avrshire Collieries Corp.

PORESEEING the long-range need for deep mine development, Ayrshire Collieries Corp. acquired some 10,000 acres of coal land in Sullivan County, Indiana, in 1943. Known as the Thunderbird Property, this land now holds the newest major underground mine in Indiana. Thunderbird mine will produce some 1,300,000 tons of steam coal annually, all to be consumed by the new Breed Station, a 475-kw generating plant of Indiana and Michigan Electric Co.

This arrangement, whereby a power generating station is located in or near a coal field many miles distant from the utility power load center, is a modern trend. In this instance power from the Breed Station will be carried at 330,000 volts to load centers in northern Indiana and southern Michigan.

The Thunderbird property consists of a roughly rectangular area of 10,000 acres, approximately four miles on a side, and is located 20 miles south of Terre Haute, Ind., just off U. S. Highway 41. The power plant sits on the banks of the Wabash River, 11 miles west of the mine. Coal moves over a private railroad owned and operated by Thunderbird Collieries Corp.

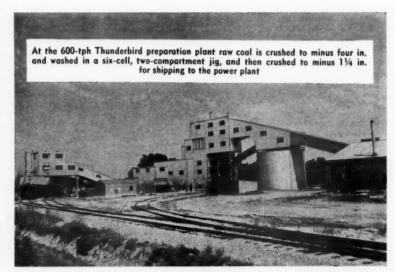
Sales Contract Influenced Mining Plan

Mine and power plant are tied to each other under a long-term fuel contract. The economies inherent in such a cooperative arrangement are evident. The contract, therefore, has had considerable influence on the mining plan, type of equipment, and preparation process chosen for Thunderbird.

There are three mineable seams on the property with an estimated 100,000,000 tons of recoverable coal. The No. 6 (listed geologically as Indiana VI) lies about 200 ft below the surface at the present plant site, and contains some 35,000,000 tons of recoverable coal. The No. V seam lies 70 to 90 ft under the No. VI and has an estimated 21,000,000 tons reserve. One hundred and forty ft below the No. V seam lies the No. III. This seam has another 35,000,000 tons of recoverable coal.

Present mining is confined to the No. VI seam which ranges from 55 to 70 in. in thickness and has an average thickness of 64 in. It contains three distinct clay bands which vary up to two in. in thickness. The bottom band occurs from eight to ten in. above the hard fire clay bottom, the middle band is approximately two ft higher, and the top band is found about 11/2 to 2 ft below the roof. Pyritic inclusions are present in the seam, chiefly near the roof. The immediate roof is a hard sandy shale from 7 to 25 ft thick, the next stratum is a four to six ft thick sandstone, and hard sandy shale from 7 to 30 ft in thickness overlies the sandstone.

The master plan for mining the No. VI seam is to divide the rectangular property area into four quadrants and develop each quadrant successively.



Indiana's newest major underground coal mine produces 1,300,000 tons annually, all of which is burned at a power generating station 11 miles away

First Coal Produced In 1959

Operations to open the initial mine at the center of the Southeast quadrant were started in March 1958, and first coal was produced February 10, 1959. Selection of the Southeast quadrant as the initial mining area was based on the proximity of an area suitable for development of a fresh water lake in the northwest corner of the quadrant.

This fresh water reservoir spreads out over 150 acres and contains 171,500,000 gal of water. Make-up water for the preparation plant is pumped a distance of 4500 ft. Refuse is drained into a settling basin that overflows and drains into the water reservoir. This assures a closed circuit for the make-up water for the tipple.

The choice of a central quadrant point for the mine opening was dictated by good engineering practice to maintain equal haulage distances from the most distant points of the mine. The preparation plant, located at the initial mine opening, will serve mines in the other quadrants also, with raw coal transported to the plant either overland or through mine haulageways to the foot of the slope developed for the Southeast quadrant mine.

Surface buildings include a 600tph wet-washing preparation plant, a laboratory for fuel analysis, a wash house, first-aid and lamp house adjacent to the manway slope, a compressor station to supply 10.000 psi high pressure air for coal shooting, a storage building for bulk supplies, a supply slope hoist building and a fan house.

The mine is exhaust ventilated by a six-ft Jeffrey Aerodyne fan located on the surface at the ventilation slope. The supply slope is the main intake opening. Intake air flows toward the producing areas in the three right and main entries, facing inby, is split for the panels, and returns to the fan in the three left-hand main entries. The middle entry in the

mains and panels where the belt conveyor is located is on intake air. Incombustible stoppings and overcasts are used

Mine offices, warehouse and repair shops are all housed in one service building. The office section contains the superintendent's private office, mine chief's office, mine engineers maproom and office, and a general meeting room for special meetings. We do our own heavy repairs, including the locomotives and railroad cars. Therefore, the shop is equipped with overhead cranes and hoists, a screw

machine and a heavy duty lathe. Experience at other underground mines, plus analyses of comparative costs, were instrumental in the selection of an a-c power system. A company owned substation located adjacent to the preparation plant provides power for both the surface operations and underground mining equipment. Power comes into the substation at 67 kv and is stepped down to where it reaches the face equipment carrying 460 volts. The entire mine is on a-c power.

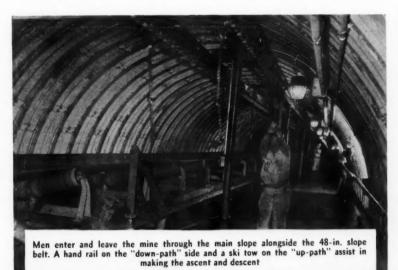
Fifty-Five Percent Area Recovery

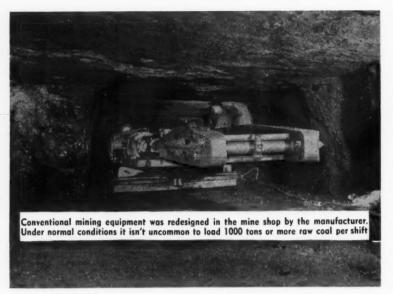
The underground mining plan is the standard midwest panel system with no pillar recovery. Estimated recovery following this plan is 55 percent of the coal in place.

Main entries, seven in number, will be driven 4000 ft north and 4000 ft south from the foot of the R-O-M slope. Seven-entry mains will be driven east and west to the property boundaries off the center and extremities of the north and south entries. The panels will be driven north and south from the east-west mains.

Entries and breakthroughs are driven 14 ft wide with conventional off-track equipment, and 13 ft wide with either Lee-Norse or Colmol continuous mining machines. Main entries and rooms are driven on 50-ft centers, and breakthroughs are on 60ft centers. Panel entries are driven on 50 or 60-ft centers. Rooms are driven 250 ft deep and 22 ft wide with conventional equipment and 18 ft wide with both the Lee-Norse and Colmol. on 50-ft centers. Three panel entries are carried through the 150-ft entry pillar to the first room, then five entries are carried to the 1500-ft panel limit. Each panel is designed to make 27 rooms on a side, or a total of 54 rooms. Panels are driven on 750-ft centers, with a 50-ft barrier between adjacent panels and also between abutting panels. Barriers, 200 ft thick, are left between panels and adjacent

On the basis of an average seam





thickness of 5 ft 4 in., each panel will produce 112,900 tons of raw coal. The Southeast quadrant is designed to produce approximately 11,000,000 tons of raw coal.

tons of raw coal.

Entrance to the mine is gained through three slopes—the R-O-M belt-manway, supply and air slopes. Personnel entering or leaving the mine use the main slope only. A hand rail on the down-path side and a ski tow on the up-path side assist in making the ascent and descent. Workmen can reach the surface in four minutes with the help of this ski tow.

The supply slope serves a dual purpose—it furnishes access for incoming and outgoing supplies and machinery, and acts as the main course for air intake. Supplies, including rock dust, ties, timber, rail, etc., are loaded by one man using a fork lift tractor onto rubber-tired supply cars that ride piggy-back on track-mounted supply dolley cars. When the dolley cars reach the bottom, a Jeep can back up to the drop-car, hitch up to the rubber-tired supply car and proceed to the face, or wherever the supplies are needed, without wasting any time in rehandling the load. Thus, supplies can be moved from the warehouse to the face with one man on top loading and one man below doing the hauling.

Men are transported from near the foot of the man-slope to the face in 16-man Kersey mine cars. We generally use two cars to a tow. It is estimated that haulage time from the

man-slope to the extreme face will take 15 minutes with this system.

Using Both Conventional and Continuous Mining Equipment

Originally the mine was to be entirely on off-track conventional a-c powered equipment. Subsequent roof conditions have caused us to alter our original selection of equipment, and we are presently operating two Lee-Norse, one Colmol and two conventional sections.

Each piece of equipment was selected only after weighing its comparative merits for both production and maintenance. High capacity was a desirable feature, but the ability to stand up under rugged conditions also counted heavily. The final selection represents, in management's opinion, the best machine for the condition under which it will be subjected at the Thunderbird Mine.

Roof control has been our biggest problem. To meet it we use Jeffrey 56 RDR single and dual boom roof drills. Roof bolts 3/4 in. by 4 ft, with bail type expansion shells are placed on four-ft centers in a 4–3–4 pattern. Where the roof structure appears weak we substitute longer bolts. Normal torque on these bolts is 170–180 lb. Steel rail and timber are used to support main haulage ways and also to supplement roof bolts in weakened areas.

The coal faces are undercut by a two-man crew using a Jeffrey 70 URD cutter. This particular machine is powered with a 75-hp motor driving a nine-ft cutter bar. We have been averaging 28 to 30 cuts per shift under normal conditions.

Face drilling is done with a Joy CD-43 dual boom one-man coal drill. The operator uses hydraulic power to position one drill, starts its operation, then positions the second boom. While the operator is positioning the second boom, the first boom has started its bite. When it has completed its hole, the drill retracts automatically and is ready for positioning again. An operator can drill an average of 300 holes per shift.

Eight to ten holes are shot by compressed air per place using the following order: bottom middle, center middle, upper middle, bottom left, middle left, top left, bottom right, middle right and top right.

Loading by the conventional equipment is done with Joy 15 BU 2 loaders. This was originally the 15 BU 1 A, but after undergoing a complete redesigning in our shop by the manufacturer, it is now called the 15 BU 2. It is a new type loader which



has a high rate of capacity. Under normal conditions it isn't uncommon for us to load 1000 tons or more of

raw coal per shift.

Coal is transported from the loader to Columbus-McKinnon Ratio Feeders via Jeffrey 66B4 shuttle cars. We normally assign two buggies to a loader. Experience to date shows an average load of five tons per buggie off conventional loaders and six tons from a continuous miner.

Our experience with Ratio Feeders at each belt head has been most satisfactory. The shuttle car dumps its five or six-ton load in approximately 25 seconds. The feeder slows this surge down so an even load is fed onto the belt in a minute and a half. These feeders have lowered our conveyor motor wear, aided in prolonging belt life and really save in man hours, since very little clean-up work is required at the dumping points.

Since the opening of the mine we

Since the opening of the mine we have supplemented our off-track conventional equipment with three continuous miners—one Jeffrey 76BM Colmol and two CM38Y Lee-Norse's.

The Colmol is run off a 440 volt a-c cable distribution and has one 50-hp hydraulic pump motor and two 100-hp drive cutting motors.

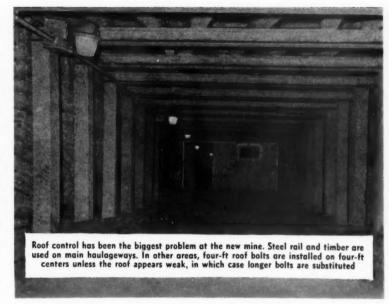
The Lee-Norse equipment is the newest. The first machine went underground the last week of 1960 and the second machine in May 1961. Both machines are run off a 440-volt accable distribution with one 75-hp hydraulic pump motor and two 75-hp cutter head motors.

Conveyor Haulage from Section to Outside

To trace the flow of coal from the Ratio Feeders to the surface we travel over three sets of all-rubber conveyor belts. Panel belts are 36 in. by 1500 ft and travel at 400 fpm. Main entry belts are 4000 ft long and 42 in. wide, driven by one head moving the belt at 475 fpm. The main slope belt is 48 in. wide and travels at

413 fpm.

Raw coal discharges from the 48-in slope belt onto a 6 by 12 ft Ripl-Flo vibrating screen with four-in. round hole openings. The plus four-in material is crushed and blended back in with the original screened product. When necessary, the composite minus four-in. coal is diverted to a 1000-ton surge bin. Coal from this bin can be fed to the slope belt to supplement a slack load, or as sole feed to the plant. When plant feed is restricted to surge bin coal, the scalping screen and breaker are by-passed. This arrangement permits the tipple to have



a steady flow of incoming coal.

After the coal has passed the scalping screen the oversize is crushed and blended back, and the coal is then fed into a six-cell, two-compartment Baum type jig.

To complete the preparation; the washed coal is screened, the 4 by 11/4 in is crushed to minus 11/2 in all

in. is crushed to minus 1¼ in.—all minus ¾ in. material and water are flumed to a settling tank. dewatered in two 36-in. centrifugal dryers, then added back to the clean 1¼-in. coal

on the loading belt.

The loading belt performs as an extensible takeup belt that can load rail cars automatically. The belt moves at a regulated speed permitting enough coal to be discharged to load a car by the time the loading mechanism has traveled the length of a car. Electric eyes attached to the loader permit the coal to be diverted from

forward to backward feed, thereby eliminating the necessity of shutting off the flow of coal while switching from one car to the next. Our loading plan is to load on one side going out to the end of the trestle, and switch to the opposite side on the return trip.

The preparation and loading process has been designed for a minimum of manpower. Only three operating men per shift—washer operator, oiler and clean-up man—are required to operate the plant at full capacity.

A two-man crew—operator and brakeman—operate our 1200-hp Fairbanks-Morse engine used in hauling the coal from our tipple over the 11 miles of Thunderbird rail to the Breed Station. The average train consists of 18 or 20 cars and the trip is repeated four times each day on a five-day week basis.

Washed coal is transported the 11 miles from preparation plant to power station on a companyowned railroad





Lower blasting costs in the mine!

Until a year ago, all shots at B. S. & K.'s Silverbell, Arizona Atlas Mine were fired with 40% standard gelatin dynamites. In January of 1960, however, test shots showed that Cyanamid's ammonia dynamites CYADYN® No. 5 and CX-327 were equally effective, more economical and produced fewer annoying fumes. CYADYN No. 5 was chosen for its higher stick count and has given satisfactory, economical breakage. Fragmentation is approximately minus 6" in ore and 10" to 12" in waste. No set blasting pattern is followed because of irregularities in the ore-bearing strata. In drifts and raises, a center cut is made with a "5-hole burn" with the outside 4 holes shot to the unloaded center hole. The rest of the round is broken to the center cut. Similar blasting procedures using Cyanamid regular delay electric blasting caps are being used in sinking a new 600-foot shaft.

Cyanamid's complete assortment of dependable high explosives, permissibles, blasting agents, electric blasting caps and other blasting accessories are available for prompt delivery from a nationwide network of plants and magazines.



Lower cost-plus-tails in the mill!

and 16 to 32% Zn, in a 100-ton/day selective flotation mill. Mill feed averages less than 1% Cu and 25% Zn. Copper occurs as chalcopyrite.

Original reagent use called for 0.1 lb./ton AERO® Promoter 404 in ball mill and 0.35 lb./ton SODIUM AEROFLOAT® Promoter in zinc circuit. In 1959, when it became economically attractive to maintain a zinc concentrate grade of not less than 60%, Cyanamid's local Field Representative and B. S. & K. personnel reworked the reagent schedule.

By using Cyanamid Experimental Reagent S-3258, a new oily collector, as zinc circuit collector, zinc recovery is maintained at 98 to 99% despite wide variations in metal content of feed, Zinc concentrates now assay well over 61% zinc, compared with a previous average of 58.5%. AERO Depressant 633 in zinc cleaner circuit helps depress undesirable lime and magnesia gangue. AEROFROTH® 77 Frother appears more selective toward gangue than other frothers and substitution of AERO Xanthate 343 for AERO Promoter 404 has improved selectivity in copper circuit. These changes have reduced reagent consumption, improved both concentrate grades and over-all recovery and made metallurgy at this mill outstanding in its field.

Cyanamid offers the widest range of metallurgical chemicals available from a single source. Our experienced Field Representatives, backed by the services of our Mining Chemicals Laboratories, stand ready to advise you in the selection and use of the best reagent combination for your mill.

FROM DRILLING TO MILLING, SPECIFY

CYANAMID

AMERICAN CYANAMID COMPANY

EXPLOSIVES AND MINING CHEMICALS DEPARTMENT BOUND BROOK, NEW JERSEY

Practical Dust Control

Flexible air transmission duct is most commonly used on second-ary ventilation. Duct diameter, as fabricated in Butte and except for special cases, is 12, 16, or 21 in. However, for high pressure blowing and all secondary exhaust systems 14 gage, 211/4 in. ID Naylor pipe is used. Much experimentation has been conducted with other rigid pipe such as wood, plastic, fiber board, and fiber glass

A well-planned primary and secondary ventilation program fosters good dust control

By FRANK J. LAIRD, JR.
Assistant Chief Ventilation and
Industrial Hygiene Engineer
The Anaconda Co.

The Anaconda Co. in Butte, Mont., has played a major role in standardizing laboratory and field techniques in dust determinations.

Standards, or maximum permissible limits, of dust concentrations have been

established by reputable agencies both in the United States and abroad. These standards suggest a maximum dust concentration which in the normal worklife will cause no pathological reverses.

The purpose of this article is only to illustrate major control methods omitting details and theory.

IMPORTANCE OF DILUTION

Well planned and controlled ventilation is essential in any operation that produces dust. It provides the industrial hygiene engineer with the opportunity of dilution.

Most contaminants, dusts, smokes, gases, fumes, mists, vapors, and some radiations can be diluted.

The contaminant concentration decreases proportionally to the fresh air increase whenever the resulting volume is homogeneous.

Any air stream contaminant that is

discharged to atmosphere, such as stack effluent, is greatly diluted.

All of the operations in the underground mining cycle can produce dust of various concentrations. When dilution is inadequate, even low level dust operations such as drilling, mucking and timbering, offer a potential hazard through buildup.

A positive primary and secondary ventilation program fosters good dust control.



In our cooler mines it was sometimes difficult to keep the bag discharge at the proper distance from the working face. An end piece was developed to deliver air at high velocity over the heads of the workers and thereby causes them no discomfort. This flat, tabular ribbon of air sweeps the face and forces all contaminants from the heading at an elevation below the breathing zone

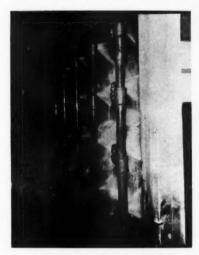
An established ventilation rule pertinent to the Butte operation stipulates that auxiliary ventilation must be provided on all operating sills and that the bag discharge be within 30 ft of the breast. Similarly, the bag discharge in a raise must be within eight ft of the back.

These distances were not chosen arbitrarily. They became established only after continuing dust surveys and a research program in cooperation with the U. S. Bureau of Mines proved the maximum distance of bag discharge from the face for minimum air recirculation and minimum dust buildup at the face. Also, regardless of air temperature, no sill heading may be advanced more than 25 ft from fresh air and no raise above the first floor without auxiliary ventilation. To provide this secondary ventilation, there are available in the Butte operation approximately 1000 auxiliary blowers



AIR CONDITIONING SUPPLEMENTS PRIMARY VENTILATION

All primary ventilation is definitely planned into the active mining area. Fresh air is provided to the stopes with



At each of the underground plants air is not only conditioned for temperature but also for quality. The plant inlet is provided with an efficient air washing chamber. Secondary air is cleaned before cooling and subsequent distribution

positive displacement in the service raises.

Whenever it is necessary, such as in some hydraulic fill stopes, a small auxiliary blower is provided on the operating floor of the service raise to guarantee displacement and dust control at the breast.

To supplement the primary ventilation system and afford dilution, air conditioning is incorporated in some of our mines. In Butte, two large high pressure systems supply coolant to the underground plants. The present systems have a capacity of 2500 tons of refrigeration per day.



Heat transfer at the underground plants is accomplished with the use of extended surface heat absorbers. This particular plant conditions 75,000 cu ft of air per minute. Dehumidification of air passing through the plant often approaches eight gpm. Our large plants provide conditioned air to mining areas with long term projected life

OPERATING SHAFTS ARE DOWNCAST

As previously stated ventilation is paramount in any underground dust control program. Most important in planning and design is the primary ventilation system which induces the initial or primary air through the mine.

All of the high volume, high pressure surface fans now in operation are pri-

marily exhausting. This induced negative pressure maintains all operating shafts downcast with fresh air and only the non-operating shafts upcast.





A complete knowledge of airway friction factors, air density and natural draft effects are imperative before fan size can be determined. This particular fan exhausts 250,000 cfm and is in series with other underground boosters. The total pressure on this system is 30 in. water gage. It should also be noted that to insure air displacement in the mine a standby fan has been installed to operate whenever the main exhaust fan is inoperable. All surface fans are reversible to facilitate control in the event of fire. Over 12,000 hp are used for ventilation, air conditioning and dust control in the Butte area.



In shafts, at station elevation, we commonly use an air water mist spray of our design. Fine atomization of the water is achieved and puddling is kept at a minimum. The sprays are operated intermittently but guarantee control during the hoisting cycle



Full cone water sprays are used in some slusher lanes without the adaptation of compressed air. Care must be taken not to appreciably increase the moisture content of the ore stream which can cause hang-up in rock transfer and other difficulties

ALL WORK PLACES ARE WET DOWN

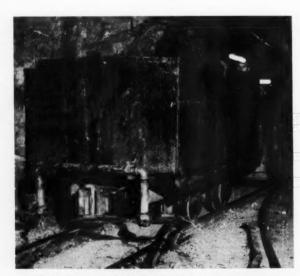
To assist ventilation wetting down is necessary in dust control. At the beginning and during each shift all working places must be wet down regardless of cycle.

Sprays of various types, patterns and sizes have been interposed at points in the rock stream and haulage both to allay dust and prevent its dispersal. Considerable investigation is necessary in choosing the proper spray for each particular job. Once dust becomes airborne it is difficult to remove from the airstream without retention equipment.

To prevent dust dispersion, during and after a blast, all sill headings must use a compressed air and water blast installed within 30 ft of the breast.

The expanding compressed air effects a temperature change in any dust generated during the blast and allows the finely atomized water to globule and settle it.

Exhaustive tests have proven how effective such an installation is in both settling dust and uniformly wetting the muck pile.



To prevent dispersal of dust from high speed haulage, a water car is used to sprinkle the sill. At some mines hygroscopic salts have been used on the sill in vicinity of the shaft



Both back mounted and sill type air and water blast installations are used to prevent dust dispersion during and after a blast. A protective plate is constructed around the discharge nozzle to deflect fragmented rock

DUST COLLECTION IN BLOCK CAVING

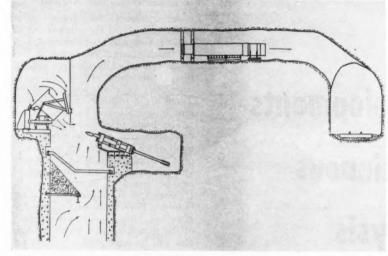
Since block caving was first introduced in the Butte area, there have been numerous changes in block design and ventilation has necessarily kept abreast of these changes.

For slusher lane ore extraction fresh air enters the block at the slusher operator location and exhausts diagonally to a ventilation fringe. Any contamination generated is exhausted away from the operator.

As ore extraction in a block is completed the slusher lanes are sealed to prevent air short circuit.



Whenever the airflow from any block is to be reused it is cleaned and diluted before being coursed to subsequent workings. This is a 24,000 cfm dust collector with high retention characteristics for cleaning used air



Due to the nature of the Butte rock, at every major transfer point and pocket in block caving there has been installed dust collection and retention equipment. This illustration schematically shows how dust capture is accomplished at the various pockets. A permanent deflector is incorporated in the pocket a short distance below track elevation to insure that all of the displaced air will be contained within the hood. Capacity is sufficient to exhaust the dust laden pocket displacement and also to guarantee continual fresh air movement downward across the dumping car

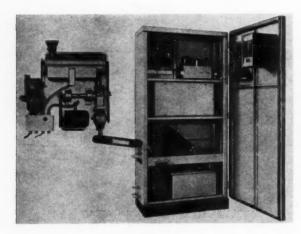
The Anaconda Co. is proud of the role it has played in contaminant control.

The average dust concentration in our underground operations is approximately two million parts per cu ft of air. This concentration, sampled and quantitated by acceptable methods, has been substantiated by various agencies as well as our own surveys. Continuous environmental improvement has been made in the various phases of our operations.

Positive action by the company, in dust control, has produced a desirable environment.

Retention equipment used both at the pockets and within the block boundaries is either the Anaconda wet-impact collector as shown here or the collector shown at the top of the page. In the past, electromatic filters have been used in series with wet collection





The Dutch State
Mines has developed a continuous
analysis apparatus,
called Cendrex, using X-ray absorption
to measure ash content

Latest Developments For Continuous Analysis

By LOY A. UPDEGRAFF
Project Engineer
Bituminous Coal Research, Inc.

Instrument makers are contributing to coal preparation technology by developing various apparatus for the rapid analysis of ash, sulphur and moisture

A LTHOUGH the cost of competitive fuels has been rising steadily for several years, coal operators have been able to market their product with practically no increase in selling price at the mines during that same period. This has been accomplished by mechanization of the mines and better facilities in the preparation plants. At the present time almost 65 percent of mined coal is mechanically cleaned and an average of 20 percent of the ROM product is discarded as refuse. As both figures go higher in the future automatic analyzers and controls will play an increasingly important part in keeping the clean coal up to customer specifications and minimizing the loss of salable coal in the rejects.

Instruments for continuous analysis and automatic controls are rapidly taking their place in the coal mining industry and in several cases have proven their value in producing higher quality products from preparation plants and at the same time increasing preparation efficiency without increased labor or maintenance costs. Instruments which can make and record analyses continuously can also operate automatic controls when the proper electric circuitry is integrated. Some of the instruments described here are already being used while others are still in the research or development stage.

Continuous Ash Analysis

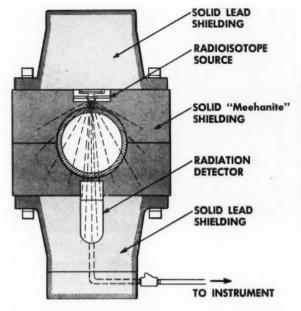
An apparatus for determination and recording of the ash content of coal by X-rays has been developed by the Dutch States Mines in the Netherlands. It is called the Cendrex apparatus or equipment and is said to be completely automatic and continuous. There are a number of installations now in operation in Europe.

The basic principles upon which this apparatus was developed and upon which it operates are quite complex. Complete details of the theory and principles of the Cendrex method can be found in an article by H. Dijkstra and B. S. Sieswerda in the October, 1959, issue of Colliery Engineering. Only a general description of the principle upon which it operates will be attempted.

When the beam of an X-ray tube strikes a given material a portion is reflected, depending upon the absorption coefficient of the material. In case of coal it was found that the absorption coefficient varies with the ash content which in turn varies the diffuse reflection. It is this diffusion principle upon which determination of ash content is based.

The absorption coefficient is also a function of the composition of the ash and of the wave length of the X-rays used. A wave length had to be chosen for which the various components of the ash would have similar coefficients. The wave length which is used in this process particularly avoids undue influence of iron content of the coal. Since ash content varies with the origin of the coal, it is desirable that the scale of the instrument be checked about once a week by the conventional ash determination method.

In operation, the beam from the X-ray tube is split in two by a two



In all nuclear gauges there is a radioisotope source and a radiation detector that measures either the amount of radioactivity passing through the medium being analyzed or that which is reflected from it. This is a diagram of an AccuRay composition analyzer in which radiation passing through the medium is measured

window diaphragm, one half striking the coal sample, the other a reference material such as plexiglass. The reflected beams strike a fluorescent screen which in turn gives off visible light. Behind the screen is located a photocell which receives the light. In front of the diaphragm is an ingenu-ous "chopper" arrangement which modulates the two incident beams in such a way that the difference in reflection between the coal sample and the plexiglass appears as a modulation of the output of the single photocell. This is amplified to actuate a recorder which is directly calibrated in percent ash.

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Coal entering the sample conditioner is dried at a temperature of 110 C., crushed to minus 48 mesh and then remixed in a mixing drum before leaving the conditioner. The moisture content of the finished product must be below one percent. Capacity of the crusher is about 300 grams per minute, and the feed must have a size range not greater than 1/2 in. by 0 inch. Time for drying the coal is about one minute. As the coal leaves the mixing drum it falls on to a small belt conveyor which delivers it to the rotary disc as shown in the picture. Coal on the disc is leveled by a straight edge, passes through



This nuclear instrument measures the specific gravity of a magnetite medium. Information from the gauge is "piped" to the control room where the operator can constantly observe the specific gravity of his washing medium

the X-ray beam and is then removed from the disc by vacuum.

Although the Cendrex system has not been used in this country up to this time, the advantages in having a continuous ash analysis system in a preparation plant are well known. When it is in operation, the time lag for response to a change in ash content of the coal being sampled is from two to four minutes to reach full scale value. With this information available and recorded it should greatly assist a plant operator in maintaining quality control. Automatic control of washing units in the plant is also a distinct possibility by having operating circuits included in the recorder and controlled by it. This system is now being introduced here by the American Minechem Co.

Nuclear Radiation

"AccuRay"

Although the use of nuclear equipment is one of the newest techniques to have been introduced into the coal industry it is fast becoming an important tool of automation for continuous measurement and quality control in coal preparation and coal handling plants. Nuclear instruments now being used in such plants are primarily density and level indicating gauges but others for measuring bulk density, moisture content, bulk flow, ash, and sulphur, have either been developed or are in the research or development stage. Practically any instrument of this type which is successfully applied can also be used to operate automatic controls in cases where such controls would be an advantage.

One of the first nuclear instruments to be used in a coal preparation plant was the AccuRay Composition Analyzer, otherwise known as a density gauge. This is an instrument which can be inserted in a circulating system and used to continuously measure and record the specific gravity, density, percent solids, or related quantity of materials flowing through pipes. As the gauge is built around a short section of pipe the same diameter as that on which it will be used, there is no physical contact of the measured material with the radiation source or detector, thus avoiding expensive maintenance due to wear or corrosion. Pipe sizes on which such gauges may be used range from 1 in. to at least 20 in. in diameter.

When the rays from a radioactive source are directed through a pipe containing coal slurry or some such material, the amount of radiation passing through the material and reaching the detector on the opposite side will depend upon the mass of the material in the pipe. A change in mass per unit volume will make a relative change in the amount of radiation absorbed. An increase in the mass or density of the material decreases the amount of radiation entering the detector which in turn reduces the electrical current signal from the detector to the preamplifier in the circuit. Current output from the detector is a measure of the material in the pipe as read out in the analyzer instrument and recorder.

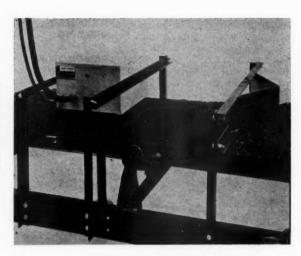
A density gauge may be used to measure the percent of solids flowing through a pipe, such as the underflow from a thickener being used as feed to a vacuum filter, or it may measure the specific gravity of the circulating wash water in a heavy media coal washing system. The instrument which receives and records the electric signal from this gauge may be located in the control room where the plant operator can see it at all times. A slight deviation in gravity can be detected at once and a correction made before the gravity gets too far from normal.

In some preparation plants using this system, gravity control is done automatically by the radiation system, with either magnetite or fresh water being added as necessary to maintain correct specific gravity within satisfactory range of the set point. In one such plant AccuRay high and low level detectors are installed on sumps to maintain proper level of the medium which supplies the washing system. A single radiation source is mounted on one side of the sump at the upper liquid level and on the opposite side are mounted the two detectors, one at the upper level and the other at the low level point. By having the two detectors interlocked with the density control unit they maintain the medium in the sump at its preset specific gravity.

The AccuRay units are so designed that there is no danger of radiation exposure to plant personnel. The radioisotope source, the detector and the pipe through which the medium flows are heavily shielded by either solid lead or by Meehanite. The radiation source is hermetically sealed and locked and is accessible only to authorized personnel. Their safety record is 100 percent thus far.

"Qualicon and d/M"

Nuclear instruments for measurement and control of moisture and bulk density in solids, liquids, and The Model 502 Qualicon gauge is designed to measure the bulk density of solid materials traveling on a belt. The measuring head contains the radio-active source as well as the detector, and reflected radioactivity is used to determine density



slurries are also marketed by the Nuclear Chicago Corp. under the trade name of Qualicon. They also manufacture nuclear instruments known as d/M gauges for measuring surface moisture, surface density, depth moisture and depth density. These gauges are portable and can be used to determine moisture and density of coal stock piles.

The instrument which has been most widely used by the coal industry thus far is the Qualicon 504 Liquid Density Gauge. This is a nuclear gauge which can be fitted into existing preparation plant piping systems in pipe sizes ranging from three to eight in. in diameter. Principle of operation is similar to that previously described, the radiation source being on one side of the pipe and the detector on the opposite side. The gauge head is a one piece Meehanite casting enclosing the gamma source, process pipe and detector chamber, thus forming a single rigid unit with solid lead shielding around the source and the detector. The electronics cabinet and recorder can be located in the plant control room if desired. Density of the slurry in a line can be automatically controlled by such a system. If the gauge is on a pipe carrying the washing medium in a heavy media plant it can auto-matically control the gravity of the medium by adding either magnetite or clear water as necessary

There is also a gauge, Model 502 Qualicon, designed to measure and control the bulk density of solid materials transported by a belt conveyor. The measuring head is mounted above the moving material and kept out of contact with it by a plow mounted up stream from it. The measuring head contains the gamma source and also the detector. Gamma rays reflected

from the material give a continuous indication of the density. The electronic section and the recorder are not shown as they are usually mounted in the plant control room. The measuring head is sufficiently shielded for personnel safety and can be put in "safe" condition at any time by a manual control. It can also be mounted on the bottom or side of a bin to measure the bulk density of solids inside the bin. A cylindrical probe which is mounted inside the bin can also be used for bulk density measurements. These measuring heads can be calibrated remotely at the electronic panel, requiring only two to five minutes. Either analog or digital instrumentation is available for recording.

A bulk moisture gauge called Qualicon 507 is available for continuous measure of moisture in certain bulk solids moving on a belt conveyor. The measuring head which is mounted above the material on the belt has two compartments, one of which contains a neutron source-detector assembly and the other a gamma source-detector assembly. The neutron source measures the percentage of moisture according to volume and the gamma source the density of the material. A combination of the two readings makes possible a resultant reading which is recorded as moisture percentage per unit weight. Although this equipment has been used on anthracite coal, coke, and some other bulk solids it is not vet recommended for bituminous coal due to the unknown effect which bound hydrogen in this coal might have upon the readings. It is expected that future research will provide the answer as to how such an adaptation can be successfully made.



Dry solids in a slurry can also be measured by integrating information from two gauges, one of which measures density, and the other determining flow. The Ohmart gauge shown here is a mass flow meter used in such a system

Another company whose nuclear gauges and allied instruments are finding their place in the coal industry is the Ohmart Corp. The Ohmart radioisotope density gauges have essentially the same basic principles as have been previously described. They have the radioactive source, the material to be measured, the detector, the amplifier, and the power supply indicator unit. The gauge is built for mounting on pipes of various sizes. The gamma source, which is usually Cesium-137, is mounted in a shielding source holder on one side of the pipe and the detector on the opposite side. The gauges are ruggedly built and sufficiently shielded to prevent injury to any plant personnel required to be in the area. They are normally built for pipes up to eight in. in diameter, but they can also be built for larger pipes and attached by bracket especially made to minimize the radiation field intensity when when they are in operation.

There are three types of detectors which may be used for these gauges: the geiger counter, ionization chamber, and the cell. The most popular type of detector seems to be the cell which converts radioactive energy directly into electrical current. With the cell as a detector it is possible to measure specific gravity ranges as

narrow as 0.150 sp gr with a six-in. pipe and 0.100 with an 8-in. pipe. A special "S" curve type unit can reduce the measuring span to a narrowness of 0.025 sp gr.

A system to measure dry solids in slurry form consists of a density gauge output applied to a density recorder and the output of a magnetic flow meter applied to a flow recorder, with the output signals from both recorders multiplied together to give a single signal which is recorded as pounds of dry solids flow which in turn can also be totalized as tons of material delivered.

A possible method of continuously measuring dry solids moving on a belt is to place a strip radioactive source on one side of the conveyor belt and a continuous stack of cells on the other and thus measure the density of the material and from that the weight. A plow would be used on the belt to provide uniform thickness of the material. Another possibility would be to measure the density of the material as it falls freely from the discharge end of the conveyor belt.

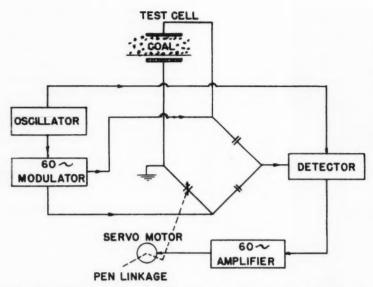
There are a number of features and advantages which seem justifiable when considering nuclear instrumentation. Among them are the following: (1) can eliminate practically all manual measurements for control of heavy media solution; (2) gives continuous and accurate recording; (3) by maintaining close control of cleaning gravity, higher quality end products can be produced; (4) can be used for complete automatic control where such control is needed; (5) since there is no physical contact between the measured material and the radiation source and detector, maintenance and wear are negligible; (6) once installed, requires very little attention and only occasional checking or calibration; (7) if used for measurement of bulk flow, moisture, or bulk density, results are instant and continuous.

Continuous Moisture Measurement

One of the most vital factors affecting the efficient use of coal and one of the most costly to control is moisture. A preparation plant using modern cleaning equipment may lower the ash in the products enough to meet market requirements and still have such an advantage offset by excess moisture. The advantages of continuous and automatic in-plant measurement and control of moisture are quite obvious. Taking coal samples for making moisture determinations requires time regardless of the method used in getting the samples, and by the time the plant operator gets the results from such samples it is usually too late to do anything about it. The direct method of moisture analysis by sampling and drying is the most accurate but the indirect method by instrumentation would be of greater benefit to a plant operator as it would record the moisture instantly and continuously thus assisting him in detecting at once any changes in drying efficiency that may develop within the plant.

One moisture measuring system which has received considerable attention both here and abroad is the capacitance system. It is an indirect method of measuring moisture as no moisture is removed from the material and the reading is instant and can be continuous if used in a moving stream of bulk solids such as fine coal. Although the readings are arbitrary they can be calibrated to indicate either total or surface moisture as determined by direct sampling

Capacitance is based upon the principle that the dielectric constant of wet solids can be measured and that it will vary according to the moisture present. The dielectric constant of water is much greater than that of coal, water being 80 and coal between 1 and 10. Wet coal should have a dielectric constant somewhere be-



A moisture measuring system which is receiving considerable attention here and abroad determines moisture content by measuring the capacitance of a passing stream of coal. The capacitance bridge circuit is shown here

tween the two extremes, depending on the amount of moisture present.

In such a capacitance system coal is the dielectric of the capacitor which in turn consists of two plates so placed that the coal flows between them. A change in moisture content of the coal changes its dielectric constant and thus changes the pen position on the recorder which is a part of the circuit. The entire circuitry is an application of the Wheatstone Bridge which contains two pairs of capacitors connected across an a-c voltage source, one pair being fixed, the other variable. One of the variables is the rebalance capacitor operated by a servo motor, the other is the capacitor through which the coal passes. Variation of moisture in the coal causes a change in the dielectric constant and imbalances the bridge. The change in voltage causes an rf signal to appear, the signal is picked up by a detector, amplified to sufficient power to operate the servo motor which puts the bridge back in balance and at the same time repositions the recording pen which is attached to the motor by a linkage system.

A typical application of the capacitance moisture measuring system in a preparation plant would be to mount the capacitor plates on a belt or apron conveyor where the coal can pass between the plates or at least will contact the positive plate. Where used in a stream of coal on a belt a vertical capacitor plate can be mounted in the coal stream and the

ground plate mounted under the belt and parallel to it. The upper plate is the positive, and the lower one the ground plate. The belt does not interfere with the lines of flux which measure the dielectric constant of the coal on the belt. This type of mounting seems to give better results than having the two plates parallel and mounted on the belt so that the coal passes between them. There is less danger of interference in the flow of coal where the ground plate is under the belt and the positive plate mounted vertically above it but imbedded in the coal stream.

Although the capacitance system of moisture measurement has shown some promising results, more study is needed to determine what effect size consist, bulk density, and petrographic composition of the coal have on the dielectric constant. Such a study is being made but the answers are not yet available. The study is being made on coal in preparation plants for the purpose of measuring and recording the moisture of thermally dried and blended coal and at coke ovens for measuring the bulk density of coal prepared for the ovens. Since the bulk density of the coal used for coke oven charging is directly affected by the moisture content, control of the moisture is of great importance. When moisture is added to fine, dry coal the bulk density decreases to a certain point and then starts increasing as more moisture is added. The desirable moisture content of a coke oven charge is

usually in the 0 to 6-percent range which is well within the limits of capacitance measurements. If a capacitance circuit can be used to accurately measure and record the moisture content of the charging coal, circuits for automatically opening and closing valves to spray oil or water on the coal to regulate the bulk density could also be integrated into the system. Experimental work on such an application of the capacitance system is being done but data on the results are not available at this time.

Summary

Not all of the instruments described or referred to in this article are used as a direct means of continuous analysis, but they are associted with automation and can play an important part in preparation plant process control. Automatic measuring and analyzing instruments together with automatic controls will be more widely used by the coal industry as time goes on and the need for increased automation becomes more apparent.

The author wishes to express his appreciation to the Industrial Nucleonics Corporation, The Ohmart Corp., Nuclear Chicago Corp., the Evershed-Enraf Co., and Dr. C. Krijgsman of the Dutch State Mines for valuable assistance given him in the preparation of this paper.

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4. Nuclear Chicago Corp., 333 E. Howard Avenue, Des Plaines, Ill.

5. The Ohmart Corp., 2236 Bogen Street, Cincinnati 22, Ohio, P. O. Box 67, Station



"You can't beat that husband of mine—he's real down-to-earth."

Careful planning of the power distribution system has paid off in maintenance savings and continuity of operation

By H. A. LONDON
Mechanical Superintendent
Duval Sulphur & Potash Co.
and

T. A. HOHING District Engineer Westinghouse Electric Corp.

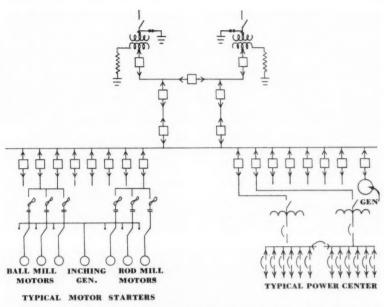
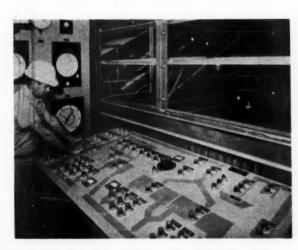


Fig. 1. Schematic diagram of electrical distribution system at Duval Sulphur & Potash

Electrical Distribution at the Esperanza Concentrator



Starting the 1250-hp ball and rod mill motors across the line is the severest voltage regulation problem for the system. Shown here is the grinding section operating console THE Esperanza mine and concentrator of Duval Sulphur & Potash Co., which are located approximately 35 miles southwest of Tucson, Ariz., started operation in February 1959. The present facilities are an outgrowth of three years of prospecting, engineering and construction.

The purpose of the plant is to take ore, which is mined by standard bench operation in an open pit mine, and mill it into copper and molybdenum concentrate which contains 25 to 35 percent copper and three to four ounces of recoverable silver per ton. The milling operation includes extensive crushing, grinding and flo-tation processes. In the final flotation process, molybdenum sulfide concentrate is the froth product and is oxidized to the oxide form by ten-hearth roasters. The copper concentrate is recovered as the tailing or unfloated mineral from the molybdenum flotation section and is filtered to the final product.

In accordance with the trend of modern ore processing plants to purchase all of their electrical energy from electric utilities rather than to generate power, negotiations were started with Tucson Gas, Electric Light and Power Co. in mid-1956. Since the source of energy was some 28 miles from the plant site, it was necessary to construct a 46-kv transmission line. This line had to be capable of stability during the start-

ing of the 1250-hp synchronous motors driving grinding mills. A simplified single line diagram for the electrical system is shown in figure 1.

Main Substation has Two Feeder Circuits

The main substation is a double ended 15,000/18,750-kva station with tap changing under load equipment which provides maximum flexibility of operation. This rating was chosen on the basis of insuring adequate starting of the grinding mill motors and provides available capacity for future expansion.

Two separate circuits are used for main plant service. These circuits are cable in underground duct banks. To quate continuity of service can be obtained with the present equipment. The switchgear bus and throat connections are protected by the transformer primary fuses backed up by the power company breakers.

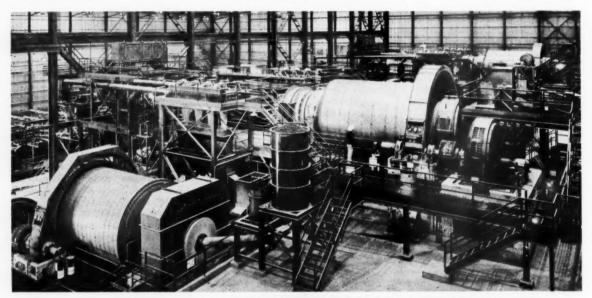
All of the switchgear breakers have an interrupting capacity which will exceed the short circuit capability of the system with double the present maximum generator capacity of the power company steam station.

The secondary windings of the power transformers are resistance grounded to limit the maximum ground fault current to 500 amp. This is rapidly becoming common practice with this type of system and its main advantage is that it limits the amount

5-kv, 2000-amp, continuous, 250-mva interrupting capacity, 37,500-amp 4-second rating and 60,000-amp momentary rating. The circuit breakers are of the drawout metal-clad type.

The distribution voltage of 4160 was chosen because it proved to be the most economical and it meets the desired voltage regulation and power loss levels. Half of the electrical load is contained in six ball and rod mill synchronous motors and these motors and associated control were a large factor in the economic choice of voltage level.

Power is fed to the indoor switchgear by two feeders, each of which is protected by a breaker on each side of the tie breaker. These breakers will



Inching control of the stepping type is included for the large ball and rod mill motors. This control applies low voltage to the synchronous motors with the field energized, causing them to lock into step at a very low speed

provide maximum continuity of service, a tie circuit breaker and two main transformer dummy breakers are used.

The tie breaker is operated normally open and is closed only when one of the transformers is out of service or when one of the plant feeder circuits is out of service. This breaker must be electrically operated to close in on load current when necessary.

The dummy breakers in the transformer circuits act as disconnect switches to take the transformers out of service manually for normal maintenance and no load tap changing. These may be changed to electrically operated circuit breakers at some future time if it appears desirable to perform this disconnection electrically. It is felt, however, that ade-

of damage that is done to equipment from a ground fault. It also prevents overvoltage due to arcing grounds on circuits with large amounts of cable.

4160 Volts was Best Choice for Distribution

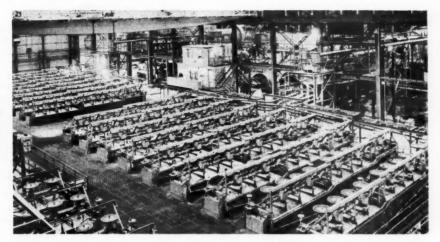
The physical arrangement of the switchgear is two parallel sections and is such that units can be added to the end of both sides of the main bus. The electrical tie circuit is made physically by a run of bus duct overhead between the two sections of switchgear. Each section is throat connected to a 7500/9375-kva power transformer and contains the main bus on one side of the tie breaker. The switchgear cubicles are outdoor construction.

The air circuit breakers used are

trip only for a fault on their respective feeders. For a fault on one feeder circuit, the outdoor switchgear feeder breaker and the indoor switchgear incoming breaker will isolate it before the breakers on the other feeder circuit operate. Since the indoor switchgear incoming breakers are equipped with directional controlled overcurrent relays, they need to coordinate only with the outdoor switchgear feeder breaker on the opposite feeder.

Indoor Switchgear are of Metal-Clad Construction

The air circuit breakers in the indoor switchgear are of the air insulation type and are metal-clad construction rated 5-kv, 250-mva short circuit interrupting capacity and 60,000 amp momentary rating. The two



Flotation section motor control centers are equipped with reversing switches on the incoming circuit so that all flotation cell motors can be reversed simultaneously, as desired. This provides for even wear on the impeller blades

incoming breakers are rated 2000 amp continuous and the remaining feeder breakers are 1200-amp breakers. All of the breakers with the same ampere frames are interchangeable.

The 1200-amp feeder breakers protect circuits to the various 480-volt power centers and circuits to the various high voltage motor control assemblies. Also connected to this bus is a 300-kw emergency generator which is automatically started in case of an electric utility company line failure.

The phase and ground overcurrent relays for these breakers must be coordinated with the relays in the outdoor switchgear feeder breakers and also with the fuses in the high voltage motor starters. All breakers except the essential load feeders and the emergency generator breaker are arranged to trip and lock out automatically in case of loss of voltage.

All of the breakers are electrically closed and tripped from a 60-cell, 125-volt station battery. The station battery is connected to a battery

charger which is continuously floated on the line and maintains a trickle charge when the battery is charged to full voltage.

Double-Ended Power Centers Used in Mill Circuit

All of the power centers are indoor, air insulated self-cooled units. The transformers are three phase, dry type, connected delta-wye and have high voltage taps to adjust the incoming feeder voltage. The transformers are close-coupled to low voltage, metal enclosed, drawout type switchgear. The transformers are also close-coupled to a high voltage, gang-operated, three-pole disconnect switch which is capable of interrupting the full load current of the transformer.

Double-ended power centers are used for the mill circuits for maximum continuity of service to these circuits. The transformer main secondary breakers are key interlocked with the tie breakers so that the tie breaker can only be closed when one

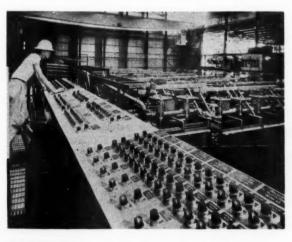
of the transformer main breakers is open. This arrangement enables taking one transformer out of service and maintaining reduced capacity service to all feeders. It also permits the use of smaller size breakers in some cases. All of the transformer main breakers have selective tripping so that for feeder fault the feeder breaker will interrupt the circuit and service is continued on all other feeder circuits. The single-ended power centers are rated up to 1500 kva. Double-ended power centers are rated 2000 kva.

The 480-volt circuit is solidly grounded. This provides fast tripping of the feeder breakers for ground faults and prevents over-voltages to the 480-volt equipment. With a solidly grounded system, the normal over-current tripping elements of the air circuit breakers are used for instantaneous tripping of ground faults.

Severest Regulation Problem is in Grinding Circuit

The primary crusher motor is a wound-rotor type. This type motor is used since the starting requirement is severe. The high inertia gyratory crusher is occasionally started under load as it may be filled with rock. At times, a large rock or tramp metal will lock the crusher mantel. For this reason the crusher motor starter is the reversing type used for unlodging the locking material.

Secondary and tertiary crushers use high torque, high slip squirrel cage motors. They are occasionally started under load. The large ball mill and rod mill motors, as well as the regrind motors, are synchronous rated 80 percent power factor for improvement of the system power factor. The maximum starting torque



Flotation section operating console from which cells can be started and stopped individually. The flotation sections are started in banks of five cells through a master relay

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occurs at about 25 percent speed and therefore special high starting and pull-in torque motors are used.

Starting the 1250-hp ball and rod mill motors across the line is the severest voltage regulation problem for the system. Tap changing underload equipment at the substation holds the distribution voltage to 4160 volts for any load which exists prior to starting one of these motors. The voltage drop was calculated to be 81/2 percent when starting the first large motor. This is well within the hold in range of any starter in the plant, and the starting torque of these motors was specified large enough to accommodate this drop. Starting subsequent motors will be easier since the motors that are running will contribute to the starting current of the starting motor.

Ball and Rod Mill Motors Have Inching Control

The development of a ground fault in the windings of these large motors is a possibility and must be anticipated as a protection requirement. The recommended sensitivity for detection of ground faults is ten percent of the normal available ground fault current. This amount of sensitivity will permit detection of a ground fault which occurs in a range of 85 to 90 percent of the stator winding. On this system, the ground relays are chosen to see a 50-ampere ground fault. Choosing the relay so that it is set on the lowest tap for for this sensitivity helps reduce the possibility of tripping during starting of the motors due to unequal saturation of the current trans-



Power equipment vault — all control centers, switchgear, and power centers are located in isolated, air conditioned vaults which are kept clear of mill and other contaminated air

formers.

All of the motor starters are of high interrupting capacity, current-limiting fuse type. They are of indoor construction and contain air insulated type contactors. The motors are protected by overcurrent undervoltage and in case of synchronous motors, pullout and undervoltage. Protection of the synchronous motors against instantaneous reclosing by the power company is provided by the pullout relays backed up by the undervoltage relays.

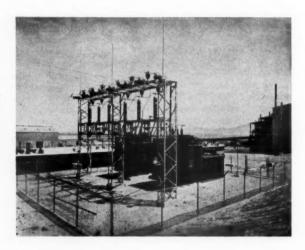
Inching control is included for the large ball and rod mill motors. This control is of the stepping type and in effect, applies low frequency voltage to the windings of the synchronous motors with the field energized. This causes the synchronous motors to lock into step at a very low speed. Transfer switches are included for each of the six synchronous motors so that the inching control can be transferred to any one of the motors

as desired. This control has proven to be an invaluable asset in the maintenance of the mills.

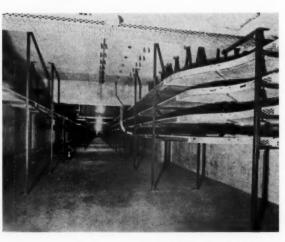
Equipment Vaults are Air Conditioned

All of the 480-volt motor control is of the motor control center type construction. This type of installation places all of the motor control in centralized specific locations which facilitates ease of installation, operation, and maintenance. Each starter is equipped with three overload relays for maximum protection of the motors. All control centers, as well as the switchgear and power centers, are placed in isolated vaults which are air conditioned and kept clear of mill and other contaminated air. All of the large main conveyor belts are cushion-started for the protection of the belt. The feeder conveyor belts, which take material from the fine and coarse ore bins, are controlled by variable frequency generators. This

The main substation is a double-ended 15,000/18,750-kva station with tap changing under load equipment which provides flexibility of operation







system provides regulated preset speed of these belts for maximum efficiency of crushing and grinding.

All of the flotation section motor control centers are equipped with reversing switches on the incoming circuit so that all flotation cell motors can be reversed simultaneously, as desired. This provides for even wear on the impeller blades. The flotation sections are started in banks of five cells through a master relay. This has a metallurgical advantage and speeds up the process of starting the flotation sections. The individual cells can, however, be started and stopped individually from the console desks.

Separate 2400-Volt Circuit to Open

The mining area is supplied by a separate 2400-volt high-resistance grounded circuit. The power is distributed by overhead lines and trailing cables. Portable protective switch-houses are used to protect the trailing cable circuits. These switch-houses contain the ground protection equipment, which consists of a zigzag grounding transformer, grounding resistor, and ground relay. A circuit breaker in these switch-houses provides short-circuit protection for the cable circuit and shovels.

The trailing cables feed electric shovels which are powered by motor generator sets which supply power for the Ward-Leonard controlled motors. Power is also distributed to large rotary drills by the trailing

cable.

Extensive Instrumentation in Mill

Modern practice in the concentration of copper and molybdenum ores utilizes automatic control devices extensively. This is particularly true in the milling of large tonnages of low grade ore where high efficiency and operating economies are demanded. The Esperanza mill employs extensive instrumentation and wherever possible the functions of operating personnel have been assigned to electronic-pneumatic recording and control devices.

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OUR GATEWAY CENTER, R. O. BOX 88, PITISBURGH 30, PENNSYLVANIA

By DONALD W. MITCHELL,1 EDWIN M. MURPHY,2 and JOHN NAGY³

Mining machine fires are often difficult to fight underground. The U. S. Bureau of Mines has conducted several experiments with various fire-fighting methods and agents, the results of which are contained in this report

Practical aspects of controlling an underground fire on a mining machine

N underground coal-mine fire, if A not extinguished quickly can develop rapidly, create a serious hazard. and cause loss of life and property. The problems of controlling a fire multiply with time of burning; as the fire increases in size and intensity, roof control, visibility, ventilation, and explosion prevention become progressively more difficult. Despite constant vigilance by the industry, the number of coal-mine fires is increasing. During the eight-year period. July 1952 to July 1960, following enactment of the Federal Coal-Mine Safety Act, the Bureau investigated 399 fires that caused 30 fatalities and 77 injuries. More than half of these fires burned for more than one shift; 20 percent could not be extinguished by direct attack and had to be sealed.

Extinguishing agents and techniques for controlling a fire on a simulated mining machine in an underground mine passageway were investigated at the Bureau's Experimental Coal Mine. Control operations were purposely made formidable by preheating the steel bed and the fuel and by placing the fire behind a barrier. Research shows that visibility in the fire area is a primary



factor affecting control operations; considerably less time and less extinguishing agent are required if the fire can be seen and if the control agent can be applied directly onto the burning fuel. Associated with good visibility is closeness of approach; the closer the attack can be made, the less time and quantity of agent are required for extinguishment. Approach to the fire and visibility will be hindered by smoke and hot gases backing up against the ventilating current. Use of a transverse brattice about two-thirds of the height of the entry or application of a liquid stream will aid in controlling the smoke. Liquid agents were most effective when applied as fog; however, if the attack must be made from more than 20 ft. high-expansion foam and the solid or aerated stream techniques are more practical. The extinguishing agents should be applied at the maximum

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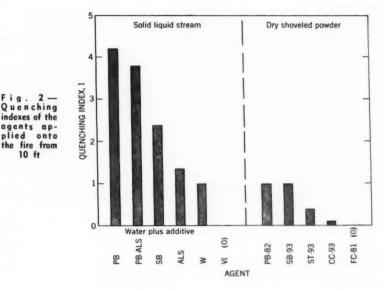
rate consistent with the equipment and supplies available.

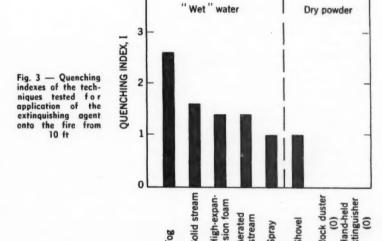
Experimental Procedures

A fire was started in which both solid and liquid fuels burned in a bed simulating a mining machine (fig. 1). The fuel consisted of a slurry of 60 lb (eight gal) of residual fuel oil with a flash point of 392°F, 10 lb of Pittsburgh coal dust (20 percent through a No. 200 sieve), and 15 lb of rubber. The coal-oil slurry was put in a steel tray three ft wide, four ft long, and four in. deep. One-half of an automobile tire (five lb) was placed tread side up in the slurry, and one tire (ten lb) was placed against the tray. A two-ft square, three-ft high barrier was built against the tray to prevent direct application of an extinguishing agent to the fire. The fuel slurry was heated to 390°F,4 ignited, and then permitted to burn freely for 41/2 minutes, after which control operations began. The fire burned at a relatively constant intensity for ten minutes and then decreased until the fuel was consumed, approximately 25 minutes. The maximum recorded temperature in the fuel bed was 1560°F. Flames extended to the roof and ribs of the protected entry.

The fire was considered to be extinguished when flaming was not detectable and the temperature of the fuel slurry was below 392°F. The fire area could then be traversed by personnel without special protection of breathing apparatus, and the additional application of extinguishing agent would not significantly reduce the heat, smoke, or steam generated.

Experiments were conducted both in a ventilated and in a dead-end entry. In the ventilated entry, all operations were conducted in intake air. The air velocities in the entry, 60-sq ft cross section, were 230, 180, and 120 fpm when the distances of attack were 10, 50, and 100 ft respectively. These velocities were just sufficient to prevent smoke and gases from rolling back on the operators at those attack distances. For experiments in a dead-end entry, some trials were made without ventilation and some with a line battice. All agents and techniques used in these experiments are suitable for use in mines and are readily available from commercial suppliers. The rates of application and nozzle pressures were chosen to prevent excessive scatter-





ing of the burning fuels and overshooting of the fire.

Results

Three parameters were measured to evaluate the extinguishing effectiveness of the agents and techniques studied. (1) T—the time in minutes required to arrest flaming by application of an agent; (2) Q—the quantity in gallons of agent applied during time T; and, (3) R—the average rate of cooling in °F per minute, computed from the time elapsed for the temperature of the fuel slurry to decrease from 1560° to 392°F (the flashpoint of the oil and the reignition temperature of the fuel slurry). To compare the effectiveness of the

agents and techniques a quenching index, I, was computed from the empirical equation:

TECHNIQUE

$$I = 1/3 \, \left(\frac{T_s}{T_x} + \frac{Q_s}{Q_x} + \frac{R_x}{R_x} \right)$$

in which the subscripts "s" and "x" are the data from the standard and given test conditions respectively. The standard test condition utilized water from the city mains applied as a solid stream at the rate of 60 gpm from ten ft. To facilitate comparison between dry powers and liquids, 100 lb of dry powder applied at a rate of 100 lb per minute was assumed to be equivalent to 60 gal of water applied at a rate of 60 gpm; for attack from ten ft these were the optimum quantities and rates required

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^{*}According to Bureau of Mine Schedule 2F, the maximum temperature the surfaces of a permissible mining machine may attain is 392°F (200°C).

Table 1
Definition of Symbols Used for Extinguishing Agents

Symbol		Concen- tration in water
ALS	Ammonium lauryl sulfate	0.4%
CC-93	Limestonedust, 93% through No. 200 sieve	-
FC-81	Fireclay, 81% through No. 200 sieve	-
P	A proprietary surface-active agent	1.0%
PB	Potassium bicarbonate solution	10.0%
PB-82	Potassium bicarbonate powder, 32% through No. 200 sieve	-
SB	Sodium bicarbonate solution	8.0%
SB-93	Sodium bicarbonate powder, 93% through No. 200 sieve	mon
ST-93	An impure sodium tetraborate powder, 93% through No. 200 sieve	-
W	Water from the city mains	-
VI, VIA	Viscosity intensified solutions	-

to prevent overshooting of the fire and excessive scattering of the burning fuels.

Four repetitive trials generally were made for each test condition. The range within a series of repetitive tests was appreciable in some instances; however, differences in the data between various agents and techniques were statistically significant at the 90 percent confidence level.

Effectiveness of Extinguishing Agents and Techniques

The principal agents used in the investigation are given in table 1. The quenching indexes for the various agents (table 2) show the effectiveness of the agents and techniques studied at an attack distance of ten ft in a ventilated entry. The effect of additives in a solid liquid stream, lines 1, 2, 4, 5, 10 and 20, is illustrated in figure 2. PB ranked first, having an index of 4.2, i.e., 4.2 times more effective than W; the quenching index for SB is 2.4; and, that for ALS is 1.6. Adding ALS to PB did not improve its effectiveness (lines 1 and 2), indicating that the potassium salt governed the fire controlling action. For the type of fire and methods of attack studied, the addition of viscosity intensifiers (VI and VIA, line 20) decreased the effectiveness of water.

The relative effectiveness of the dry powder agents applied by shovel (lines 11, 12, 15, 16 and 17, table 2) is also shown in figure 2. In their order of effectiveness were PB-82, SB-93, ST-93 and CC-93; the fire was not controlled by FC-81. As shown on lines 18 and 19, airborne dust from a rock dusting machine or from five 20-lb dry extinguishers applied con-

secutively did not quench the fire. It is possible that airborne dust might be effective

on this type of fire at rates of discharge considerably higher than the

80 lb per minute used. The superior exting

The superior extinguishing effectiveness of the alkali-metal salts (potassium and sodium compounds) is consistent with observations of other researchers. Many solutions and salts are even more effective than those tested here, but many of them may be impractical for use in coal mines.

Comparison between the extinguishing-agent application techniques (lines 3, 5, 6, 7, 9, 11, 18 and 19) are shown in figure 3. Fog application was the most effective. During the experiments solid stream and shovel application caused splashing and spreading of the burning oil more than did the other techniques; the high-expansion foam and fog techniques did not cause the oil to splash or spread.

The data show that for fire fighting in mines:

(1) The maximum rate of application consistent within limitation of the equipment should be used. In the research, increasing the rates of application from a minimum value to the optimum for the equipment used generally increased the extinguishing effectiveness by 40 to 60 percent.

fectiveness by 40 to 60 percent.

(2) As the distance of attack is increased, accurate application of agent is made more difficult because of the higher nozzle pressures required and poorer visibility. For the high-expansion foam technique, the decrease in quenching index with distance of attack is relatively slight; for the other techniques, the quenching index decreased markedly with distance, being twice as great at 10 ft as at 50. Use of fog, sprays, portable extinguishers, and shovels is limited to attacks from within 10 ft from the fire.

Table 2

Quenching Indexes for Agents and Techniques
at an Attack Distance of Ten Feet

Line No.	Agent	Technique	Appli- cation	Quench ing index
1	PB	Solid stream	40 gpm	4.2
2	PB-ALS	Solid stream	40 gpm	3.8
3	ALS	Fog	60 gpm	2.6
4	SB	Solid stream	40 gpm	2.4
5	ALS	Solid stream	60 gpm	1.6
6	ALS	High-expansion foam	10 gpm	1.4
7	ALS	Aerated stream	40 gpm	1.4
8	P	Aerated stream	35 gpm	1.0
9	ALS	Spray	60 gpm	1.0
10	W	Solid stream	60 gpm	1.0
11	PB-82	Shovel	100 lb/min	1.0
12	SB-93	Shovel	100 lb/min	1.0
13	W	Aerated stream	40 gpm	0.4
14	W	Spray	60 gpm	0.4
15	ST-93	Shovel	100 lb/min	0.4
16	CC-93	Shovel	100 lb/min	0.1
17	FC-81	Shovel	100 lb/min	
18	1	Rock duster	80 lb/min	0.0
19	SB-93	Hand extinguishers	80 lb/min	0.0
20	VI-VIA	Solid stream	40 gpm	0.0

1 PB-82, SB-93, ST-93, CC-93, CC-70.

(3) Four different types of wetting agents tested were equally effective when used in liquid streams. Premixing some wetting agents and storing them over extended periods of time is not desirable because of their corrosive action or instability.

(4) The finer the powder the greater its extinguishing effectiveness. The importance of the fineness of the dust is shown by the fact that despite bulk application by shovel, the quenching index increased proportionately with the fraction of the PB powder passing a No. 200 sieve; limestone dust with a fineness of 70 percent through a No. 200 sieve did not extinguish the flame.

Backing of smoke against ventilation.-During the experiments, smoke and gases from the fire flowed adjacent to the roof of the mine entry against the ventilating current. When the velocity of the air was 120 fpm, smoke backed up 100 ft; at air velocities of 180 and 230 fpm, the smoke permitted approach to within 50 and 10 ft from the fire. The thickness of the tongue of smoke appeared to be related to air velocity, temperature, and the heat radiated from the fire. The British have shown that a simple transverse brattice curtain stretched across the lower two-thirds of the entry is the most effective method for controlling backing up of the smoke and gases. Brattice curtains hung along the axis of the entry are not nearly as effective in providing a direct fresh air approach. If used, the longitudinal curtain must be nonporous and made tight against the roof and floor to prevent recircula-

In limited trials, smoke and gases

in the intake entry of the Experimental Coal Mine were driven ahead by fog, liquid sprays, and rock dust discharged from the rock dust distributor (air discharge alone from the distributor is not effective). None of the methods tried could control smoke and hot gases in a dead-end passageway except the passage of a high-velocity air current along an airtight line bratice.

Control of a Mining-Machine Fire in a Dead-End Entry

For experiments in a dead-end entry attack was made with a solid liquid stream projected from the fresh air base 100 ft from the fire. Because of poor visibility the fire was not controlled by 1000 gal of ALS even though the location and extent of the fire were known to the operators; in tests in a ventilated entry 183 gal of ALS controlled this fire from 100 ft. In a second series of experiments, a longitudinal brattice was constructed from the fresh air base to an attack distance 30 ft from the fire. Control was achieved in three minutes by 173 gal of ALS applied as a solid stream (in the ventilated entry, 56 gal of ALS controlled the fire in 1.1 minutes).

Extensive trials were made in the dead-end entry with the foam-duct generator operated at the fresh air base. In each of 12 experiments, control was achieved in 21/2 minutes by 24 gal of the ALS foam solution. This generator, shown in figure 4, is smaller and more flexible than the device previously developed by the Bureau.⁵ It is designed for fighting localized fires from distances of up to 150 ft in open and dead-end entries. The generator has an 18-in. fan driven by a five-hp motor that has a rated free air flow of 6200 cfm and a pressure potential of 6.5 in. water gauge. A regulator at the fan intake controls the quality of the foam being produced and transported. A one ft long housing on the fan exhaust contains a metal honeycomb air straightener, two wide-angle, full-cone, nozzles that spray seven or more gallons of foam solution at ten or more psi to the net, and a metal honeycombfabric net system. Although in the current research the foam solution was premixed and stored in a 200gal tank car, there are many other satisfactory methods for supplying solution to the nozzles. A roll of 24 in. diameter 0.004-in. thick polyethy-

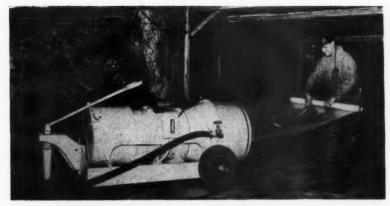


Fig. 4. Portable foam generator designed for fighting fires from distances up to 150 ft in open and dead-end entries

lene tubing is attached to the housing. For the fire fighting operations the generator is kept in fresh air and the fan exhaust pointed towards the fire. By starting the fan the tubing unrolls toward the fire. Experience has shown that should the tubing kink or become lodged it generally can be straightened by alternately closing and opening the intake-air regulator. In trials at the Experimental Coal Mine, the tubing was self-extended 130 ft out of 100 times in an unobstructed entry; in three failures a substitute tubing unrolled successfully. The tubing should extend to within at least 30 ft of the fire in a dead end; should the tubing be too long, the excess will be burned off by the fire. After extending the tubing, foam generation is started, and the foam is forced through the plastic duct (fig. 5). The complete preparatory operation can be conducted in 45 seconds. Satisfactory foam generation and transport is determined by visual observation at the duct. A decrease in density and a change in color of smoke from dark to light are good indications that a fire is under control.

Summary

These experiments have served to supplement the coal mining industry's knowledge of mine-fire control extinguishing agents and techniques. The seriousness of the coal-mine fire situation makes it vitally important that the fire-control system at each mine be reviewed carefully, objectively, and often to assure that the best possible protection is provided and maintained.



Fig. 5-Attack of the standard fire by high-expansion foam

⁵ Nagy, J., Murphy, E. M., and Mitchell, D. W., Controlling Mine Fires With High-Expansion Foam: Bureau of Mines Dept. of Investigations 5632, 1960, 28 pp.



Some 3000 tons of washed coal are loaded per shift at Allendale

The Allendale Story

By GLENN F. JACKSON

Good engineering and an awareness of responsibilities to the community apparent at new Illinois strip mine

Overburden is stripped with a remodeled 33-yd 950 B. Coal is loaded with either a six-yd B-E electric shovel or a 4½-yd diesel 93 M

A LIGHT blue preparation plant!

To a visitor this is probably the most striking feature of the Allendale mine, and it is a symbol of the creative planning and imaginative engineering that went into this modern

stripping operation.

Located near the town of Wyoming in Stark County, Ill., the mine is owned and operated by Stonefort Coal Mining Co., Inc. Samuel F. Sherwood is president and William W. Dukes is vice president in charge of operations. At the mine, Dora Sims, superintendent, and Richard McFarland, mine manager, are directly responsible for the safe, efficient production of all sizes of coal required for public utility, industrial and domestic use.

Prior Preparation of Overburden Normally not Required

Allendale, which was opened in April 1960, employs about 60 men and has a life expectancy of 20–25 years. It is mining the 48-in. Illinois No. 6 seam of coal. Overburden averages about 45 ft and consists of clay and shale which normally doesn't require shooting before digging.

A Bucyrus-Erie 33-yd shovel is used to move the overburden on a three-shift, five-day a week basis. This 950 B machine, which was purchased by Stonefort over 24 years ago for another mine, has been completely gone over, and many 1050 B features have been added. It is heated by electricity.

The shovel crew consists of two operators and a "ground" man. The operators alternate in running the machine—working on a one hour on,



All coal is shipped by rail from the mine, but truck bins have been built at Wyoming, about four miles away

one hour off basis. During their off hours they inspect the equipment and keep it oiled. The ground man keeps the area around the shovel clean with a rubber-tired dozer.

Actually, Allendale has a total of five dozers which are used, in addition to cleaning up around the big shovel, to build and maintain roads, move shovel cables, level spoils and perform many other useful tasks. Spoil banks are smoothed to gently rolling contours and tipple refuse buried—all voluntarily by the company. Stonefort deserves much credit for its reclamation work.

Ripper used to Break the Coal

After the coal seam is uncovered, a D 9 Cat rips the coal for loading.

Two shovels are used for loading—a Bucyrus-Erie six-yd electric shovel and a 93 M Marion 4½-yd diesel. In addition, a Bucyrus-Erie 54 B electric unit is used for a spare.

Coal is loaded into trucks and hauled to a dump which has a bin capacity of 100 tons and is located near the preparation plant. Six trucks are available, four 40-ton and two 25-ton Euclids, but the smaller trucks are used as spares. The haulage distance is under one mile.

Knowing the value of good roads, management keeps one man working nearly full time maintaining haulage roads. He has a rubber-tired grader and a water truck for this purpose. The mine also owns a six-yd Bucyrus-Erie 200 W dragline which is used mostly for making box cuts and doing road work.

Plant Has 600-tph Capacity

The steel-clad preparation plant is a practical and attractive building designed by Roberts & Schaefer Co. The ribbed wall panels are blue and the roof sheets are grey.

A feature of the steam heated plant is the Coal-Pak automatic stoker-fired boiler developed by Bituminous Coal Research, Inc. Rated at 2,400,000 Btu per hour, it is fed with coal from within the tipple and ashes are discharged into the gob. A particular advantage is that it can carry itself over the weekend without attention.

Another feature of the plant is its compactness. Full use has been made of gravity—even the flow to the settling pond and reservoir is by gravity. Thus, the use of conveying equipment has been held to a minimum and the flow of coal through the plant is mostly vertical rather than horizontal.

The r.o.m. feed starts at the 100-ton truck dump where a reciprocating feeder delivers 650 tph of coal to a 48-in belt. Coal travels to a rotary breaker which reduces it to minus four-in. From the breaker, a 42-in stacker belt conveyor moves it to a 1000-ton (live) raw coal storage pile. Total capacity of this storage pile is

2000 tons.

Beneath the storage pile, reciprocating feeders regulate the feed at 600 tph of 4 in. by O raw coal to a 42-in. belt conveyor.

The 4-in. by O material from the conveyor is fed to a Baum type jig equipped with three primary and four secondary cells. Cleaned 4-in. by O is sluiced over two stationary dewatering screens with three-mm openings for discharge to two vibrating dewatering and sizing screens. These primary screens are double deck horizontal units, the top decks making a separation at 1½ in. and the bottom decks at ¾ in.

Minus ¾-in. by O washed coal from these screens is further dewatered over two stationary screens which are duplicates of the stationary screens ahead of the vibrating screens. It is then delivered to two fine coal dewatering screens for a separation at ¼ in.

The minus three-mm product from the four stationary dewatering screens, together with the minus ½ in. from the two fine coal dewatering screens, is gathered in a fine coal sump. The settled ½ in. by O is pumped to two banks of three 24-in. cyclones. The underflow from the cyclones passes over a single deck desliming screen dressed for a 28-mesh separation. The ½ in. by 28 mesh from the desliming screen is



The platform at this fueling station has been so arranged that the truck driver can step directly onto it— saving valuable time and improving safety at each refueling stop



To get the needed supply of water for coal preparation, a 1510-ft well was drilled.

Well water is pumped to a reservoir which holds a five-day supply



The main office, engineers' office, warehouse, machine and welding shop and garage are all housed in one electrically heated building

then fed to a centrifugal dryer for mechanical drying.

Depending on orders, the cleaned 4 by 1¼-in. and 1¼ by ¾-in. products from the two primary dewatering and sizing screens may be sold direct or diverted to two crushers for reduction to minus ¾-in. Each of the two crushers may deliver to two 24-in. belts which feed two double deck screens for removal of the minus ¼-in. from the stoker coal product.

The $\frac{3}{4}$ by $\frac{1}{4}$ -in. cleaned coal from the two fine coal dewatering screens plus the $\frac{1}{4}$ -in. by 28-mesh from the centrifugal dryer may be diverted to three dryers for thermal drying.

Rail Service Only at Mine

Two railroads service the mine: Chicago & North Western Railway, and Chicago, Burlington & Quincy Railway.

Railroad car loading is on four tracks. The bridge over the loading track is only 17 ft wide, yet turns out almost 3000 tons per shift. Layer loading is accomplished through car control by means of car retarders.

The empty tracks are spaced particularly wide apart to enable a small front end loader to run between them, picking up trash that is thrown out by car cleaners, without having the loader catch itself on railroad ties. This eliminates the hand labor that is otherwise required in cleaning up.

All coal is shipped by rail from the mine, but a truck loading station is maintained at Wyoming. Rail cars dump into a bin at this point. A feeder underneath the bin feeds the coal onto a conveyor which carries it up to the truck bins. They have a total capacity of 650 tons.

Company Goes Down 1510 Ft for Water

To obtain fresh water for the preparation plant, a 1510-ft well was drilled. A deep well pump, which can be operated manually or automatically, is used to pump the water to the reservoir—which holds a five-day supply. Generally the pump is operated automatically by radio control from the plant according to demand on plant water.

The preparation plant requires a fresh water supply of 2000 gpm, or nearly a million gal per shift.

The main office, engineer's office, warehouse, machine and welding shop, electrician's facilities, and the garage are all housed under one roof. Heated by electricity, this building also employs blue steel panels except for brick facing around the office area.

Developments in Large Borehole Drilling

By H. EUGENE MAUCK
Vice President—Operations
Freeman Coal Mining Corp.
and
D. C. RIDENOUR
General Superintendent
Olga Coal Co.

Large borehole drilling at Olga Coal Co. has in 11 years evolved through churn and Calyx drilling to the present method of using rotary equipment

E LEVEN years ago there were very few large diameter drill holes in use in coal mines of the United States. Entrances to deep mines were by shafts or slopes which at best were costly and in many instances larger than necessary.

There are many applications where smaller shafts could better serve the problems of ventilation and access, especially as escapement in an emergency. Thus the question arose as to whether smaller shafts could be drilled that would answer the needs. This eventually led to a series of drillings in Olga Coal Co. mines which over the years have continued to improve and develop the science of large diameter borehole drilling.

To the knowledge of the authors no coal mining company has had any more experience than Olga in the numbers of large diameter holes drilled and methods of drilling them. Seven holes have been drilled over the past 11 years, varying in size from 30 in. diam to 76 in. and from 466 ft deep to 976 ft. Three completely different methods of drilling have been used.

It is management's belief that the order in method of drilling which was followed was progressive because each one was drilled faster and at less cost than the previous. The development of the drilling technique proved both interesting and educational. Not only did it prove satisfactory in this company's mines but it aided in the development and acceptance of large diameter borehole drilling by other companies.

Large Diameter Shafts Were Not Needed

Olga Coal faced two fundamental problems in its large, deep mines; namely, the removal of methane gas and the lack of adequate escapement facilities. To sink or construct customary shafts to overcome these problems was expensive and unnecessary.

It was unnecessary because standard diameter shafts of 16 to 20 ft

Strata penetrated by the boreholes include shales, massive shales, sandstones and various coal seams. In no instance was the strata so massive as to cause difficulty in pulling cores

were much larger than required. Several small shafts would best serve the purpose. Various drilling companies were contacted since two or three holes were known to have been drilled up to that time. None of the drilling companies would attempt this job because of the hard characteristic of the rocks and the depth of the holes desired.

Management then started working with a local driller who had been churn drilling the company's boreholes up to eight in. in diameter. However, he had drilled holes up to 22 in. in the locality. He agreed to attempt the drilling. The contractor worked with the company's engineers and a manufacturer in developing a set of drills which would ream 13½ in. holes to 30 in. and to 48 in. It was a start but the system was slow and costly. Three holes were drilled in this manner.

The next two holes were drilled by the Calyx method, utilizing a barrel and chilled shot. Cores were pulled from the hole. The third method used was that of rotary drilling making use of Hughes cutting bits mounted on a special powered barrel. Cuttings fell into the mine. This appears to be the fastest and least expensive method to date.

Shafts Act As Upcasts

Over this 11 year period the company spent \$514,000 on seven holes which have well served their purpose in ventilation and escapement. These holes ring the property. Since the mines utilize a pressure system of ventilation, these shafts act as upcasts and allow methane laden air to escape behind the mined out areas. As long as the holes are accessible to the mine workings, they act as escape shafts.

The mines are located in southern West Virginia where the terrain is rough and the borehole locations relatively inaccessible.

The strata penetrated by these holes include various sedimentary rocks, such as shales, massive shales, sandstones—some of which were exceedingly hard—plus various coal



Pulling of cores is scheduled to conform with known partings, which is particularly important in massive rock strata. When a core cannot be broken off by pulling, t is necessary to break it loose by

seams. Some of the rock strata was thinly bedded while others were more or less massive. In no instance, however, was the strata so massive as to cause difficulty in pulling cores. In all cases, the bedding plains were horizontal. Some drilling was done through old caved mine areas. All of the holes were drilled into accessible portions of the mine.

Pregrouting was done for all of the holes in more or less the same manner. Standard diamond core or churn drill holes were drilled through the water bearing strata. Grout was pumped in at 400 psi or greater, in progressive steps of 50 to 100 ft beginning at the bottom of the hole and rising toward the surface.

These pregrout holes were located at equal distances around the circumference of the projected large diameter hole at a distance of about two to three ft from the circumference. Usually four and sometimes six holes were required to adequately seal off the water. In all cases except one, very good results were obtained in sealing the water from the large holes. The only exception is the last hole which was drilled and which is now being lined with corrugated tunnel liner through the water bearing strata. Grout is being pumped behind the liner after it is set in place. The results of this project are not vet known.

First Hole Drilled in Two Stages

After pregrouting was completed, the drilling of the first hole in 1949 was done in two stages. A 131/2 in. diam pilot hole was churn drilled 630 ft into the mine with a conventional churn drill bit. This hole served as a guide for the nose of the 30 in, reaming bit. The cuttings from the reaming operation fell into the mine and were handled by mine personnel.

The 30-in. bit was designed and manufactured with a pilot extension that followed the 131/2 in. hole. Five 10-in. bits were fabricated around the mandril making a five-cutter percussion bit. The result was a tool weighing 4500 lb.

The drillers alternated two of these bits, one being dressed while the other was drilling. The bit was heated to a dull-red heat in dressing. Since the bit had a nickel steel insert, the frequent heating had no injurious affect on the bit. The bits were built up with a Haschrome rod which was said to be able to resist shock but was not hard enough to serve as the final treatment, which was accomplished with a Haynes 90 or Haystellite rod. The frequency with which the drill bit had to be dressed varied from six in. of drilling to 60 ft depending on the type of rock encountered. The hardest rock required one shift to drill six in. This hole was cased with 251/2 in. ID pipe with 9/32 in. wall thickness which had a tapered bevel end for butt welding. The 630 ft of pipe weighed 48,000 lb.

Costs Were \$92.20 Per Foot

The hole was reamed to within 10 ft of the mine. The 131/2 in. hole was then plugged and ground water filled the hole to within 60 ft of the surface. A frame was built into the bottom

of the pipe and another at a point about five ft from the bottom. A onein. wire rope was fastened to the frame at the bottom of the pipe, extended up the pipe on the inside and brought out of the pipe at the upper frame. The one-in. rope extended up the outside of the pipe over a 16-in. steel sheave buried in the ground at the top of the hole and then fastened to two bulldozers. It was found that one bulldozer would not hold the pipe.

Four 1-in. by 1-in. spacers were welded near the top of every section of the pipe to space the casing in the hole. A clamp was used in holding the two ends of pipe together during the welding operation. A one-in. pipe was fastened to the side of the 26-in. pipe to hold a signal line. The large pipe was set on the bottom of the hole and grouted in. The mine then shot out the roof to the large hole and opened the pipe. Platforms were built on the surface and in the mine for access to the two decks of the escape torpedo which could be used for escapement purposes in emergencies.

This hole was 635 ft and was drilled and cased in ten months at a total cost of \$58,469 or a cost per foot of about \$92.20.

Costs Reduced 30 Percent on Second 30-in. Hole

When this first hole was completed, it was decided to drill two larger holes for bleeders but not to case them as their life as escape holes would be relatively short. Both holes were pregrouted with two 6-in. diam grout holes five ft from the center of the large holes and directly opposite. One of these was drilled and grouted before the other was started. Pressures up to 800 psi were used. When the pressure could not build up after a reasonable amount of pumping, Aquagel in the proportion of four lb per bag of cement was added to the

After pregrouting a 49-in. ID casing 5% in, thick was sunk to the rock by spudding inside the casing and washing the mud up the outside. When the casing was on rock the hole was pumped dry and a man with a jackhammer drilled the rock, shot it and loaded it out. In this way, the casing was lowered three ft into solid rock. The casing was then grouted in. A guide was set inside the 49 in. casing for starting the 131/2 in. pilot hole. As soon as the 13 in. bit and tools were in rock, the guide was removed. The 13 in. hole was completed and then reamed to 30 in. by

churn drill methods.

The drilling and grouting of the second 30-in. hole cost \$45,094 or about \$67 per foot. The total depth of the hole was 677 ft.

The third hole was drilled and reamed in the same manner as the first and second holes but using a bit designed for reaming to 48 in. It weighed 6900 lb. The cost of this third hole was \$157.00 per foot. It was 595 ft deep.

Drill Hole Cased Through Coal Seam

In February 1956, work was begun on a 36-in. diam bore hole which was to be drilled from the surface to the mine at a depth of 733 ft. Prior to starting the large hole, four diamond drill holes were drilled to grout the rock strata. The first two were 400 ft deep, and the remaining two were 200 ft deep. Grouting was done at pressures of 400 psi at intervals of 50 to 100 ft. This grouting was successful for only a few gallons of water per minute were made in this hole.

A seam of coal 33 ft below the surface had been mined and the pillars robbed at the drill hole location. Consequently, it was necessary to case the hole a substantial distance below this seam. Soft and broken strata through this seam was penetrated by hand in 12 ft lifts. A 66-in. diam casing was placed in the hole and cemented in. After the concrete had set, a 58-in. hole was dug to a depth of about 24 ft and a 52-in. casing was cemented in. The process was repeated for another 12 ft with a 48-in, casing which was set on hard consolidated material. A 46-in. diam Calyx bit was used to drill to 64 ft and a 40-in. ID solid casing 64 ft long was then centered in the hole and cemented in from the bottom of the hole to the surface. In this way the coal seam was entirely isolated by both steel and concrete from the ventilation of the Olga mine.

Width of Calyx Cut is About Two-In.

At this point the 36-in, hole was started by using Calyx drilling methods. Calyx drilling, or shot drilling, received its name from the calvx of a flower due to the chip box that is installed above the core barrel to collect the larger cuttings that are deposited when the velocity of the water slows down as it passes by the top of the barrel on its way up to the top of the hole. It is an old type of core drilling in which chilled cast iron pellets or shot of varying screen sizes are used in the place of diamonds as the cutting medium.

The customary system of Calyx drilling has changed very little over One method of handling the cores, which may be up to 20 ft long and weigh as much as 17 tons, is to load them directly onto a sturdy car mounted on rails so that it can be rolled over the hole



the years. A hollow tube or barrel with slots cut in the bottom wall pick up the shot that are being rolled around in the groove cut by the edge of the tube as it is rotated by a device at the top of the hole. Water is pumped down through the drill rods to the inside of the barrel which forces the cuttings out and up along the barrel to the top of the hole. The heavy particles and worn out shot are deposited in the Calyx at the top of the barrel.

After the barrel has been filled with core, the core is pulled, the barrel and rods placed back in the hole, and the cycle starts again as in any core drilling. The width of the cut that is made is approximately two in. About 25 lb of shot are used in the hole at one time and about ten lb are used per foot of hole but, of course, these quantities vary consid-

erably with conditions.

Cores Pulled in 20-Ft Lengths

The removal and disposal of cores is an important consideration in Calyx drilling. Cores are pulled in lengths up to 20 ft, depending on the slips or partings in the rock strata and the length of the core barrel. When available the sections of the rock, as shown on diamond core drill logs, are studied by the drillers and the pulling of cores is scheduled to conform with known partings. This factor is particularly important in massive rock strata. When cores cannot be broken off by pulling, it is then necessary to break the core loose by blasting which is time consuming.

A method must be provided for

disposing of the cores on the surface. This is important since a 20 ft long sandstone core from a four ft diam hole may weigh as much as 17 tons. One method of handling is to have a sturdy car mounted on rails that can be rolled over the hole and the core removed from the barrel directly onto the car. The car is then pulled to the edge of a bank or hill and the core rolled off.

The total time required to complete a hole depends on its diameter, surface strata depth, rock strata characteristics and depth and, no doubt, luck. In the case of the 36 in. hole, the diamond core drilling of four grout holes totaling 1270 ft and the pressure grouting required 26 days. An additional 26 days were required to dig and drill the hole through the coal seam to a depth of 64 ft, set all of the casing described previously and to cement the casing.

The Calyx drilling of 669 ft required 40 days for an average 16.6 ft in 24 hours of drilling. Included in the 40 days were two days lost in getting started, due to a piece of drill steel lost in the concrete at the bottom of the hole when the casing was grouted, and 11/2 days lost in removing a wedge shaped piece of core that could not be removed by the core barrel.

Used 31/2 Carloads of Grout at One Hole

A second Calyx drill hole was completed into the mine. It was 48 in. in diameter and 976 ft deep. Since the rock was very close to the surface, one piece of 66-in. casing eight ft long was used. A 60 in. diam Calyx hole was drilled 40 ft and a 54-in. casing 40 ft long was cemented in to seal off surface water that was not shut off by the grouting. The total time spent in grouting, setting up and drilling the 48 in. bore hole 976 ft deep during very unfavorable weather conditions was 6½ months.

The total cost of the 36-in, hole as first described was \$99.95 per ft of which \$13.62 represented the costs to the coal company in preparing for the hole. The costs on the 48-in, diam hole totaled \$127.00 per ft. The road building for this hole was much greater since approximately two miles of road were graded and covered with mine refuse. The rock strata was found to be very open and as a result, 31/2 carloads of cement were required for grouting. In the cost of this hole, \$19.88 per foot was spent in preparing for the drilling. This cost is included in the above quoted figure.

Rotary Drilling Employed on Two Holes

The drilling of the sixth and seventh holes employed an entirely different method: that of using rotary oil drill hole bits which have been modified to suit the equipment of the contractor. The holes were started by drilling 12½-in. pilot holes powered from the surface.

The preliminary hole was drilled into the open mine, and was then reamed to 22 in. in diameter by rotary methods with power supplied at the surface. The cuttings were permitted to go into the mine and were loaded out by mine personnel.

With completion of the 22-in. hole, the contractor's equipment for reaming the hole to 76 in. was set in place. This included the drill head, on the bottom of which has been installed the rotary oil drill type bits.

This bottom drill head is rotated in the hole by the electric motors in the upper section of this equipment which is also in the hole. The upper section includes electric motors for propelling the lower section together with hydraulic pumps which exert down pressure on the drill head together with horizontal pressures against shoes which engage the side of the hole. These electric motors and hydraulic motors are controlled by the operator who is stationed on the surface and is well informed of the

performance of the equipment in the hole by various indicating devices.

698-Ft Hole Drilled in 47 Days

As is apparent, since the cuttings are washed down the hole and into the mine, it is only necessary to remove this drill equipment when the bits become dull and must be changed. Few operating difficulties were encountered in drilling this 466 ft hole even though the finished diameter was 76 in. The drilling time was much less than in either of the two methods previously used, and as a result, the cost was less. A total of 47 days were required to move in the equipment and complete the hole. The total cost including a road, power line, pregrouting, and stack was \$103 per foot. The cost of handling the cuttings underground was also included in this over-all cost.

A second hole, 76 in. in diameter and 698 ft deep has just been conpleted. The setting up and drilling of this hole also required 47 operating days, but the work was double-shifted since its completion was important to the company. The total cost for this hole was \$72,950 or about \$104.50 per foot.



Services that management cannot effectively or economically provide for itself can be secured through management consultants

What the MANAGEMENT CONSULTANT Can Do for the PARSONS Hamilton MINING INDUSTRY

By SHERRILL A. PARSONS

Partner Booz, Allen & Hamilton San Francisco

MANAGEMENTS of mining op-erations are in a particularly favorable position to capitalize on the use of management consultants. This position arises because of the inherent characteristics of the mining industry and the management consulting profession. Some progressive mining managements discovered this many years ago, and have developed extensive experience with consulting firms. Our purpose is to examine the nature of this teamwork for successful management. Our objective is to determine its values in helping solve the current and prospective problems in the mining industry.

Consultant is a Buffer During Market Swings

Certain characteristics of the mining industry favor the use of management consultants, and four of these serve to illustrate the point.

First—the demand for the products of mining is volatile and the industry is therefore highly cyclical. Consequently, wise managements maintain strong control over overhead costs in order to more effectively weather depressed market periods. This neces-

sity, or at least desirability, to keep a reasonably lean organization hits directly at the quality and quantity of management staff services.

If a large qualified staff is built up and maintained, a depressed cycle brings extreme pressure on profits. If, alternatively, attempts are made to adjust company staffs to cycles, opportunity is lost during the upswing because of the lag in recruitments, and training costs mount rapidly. In coming down, management must move decisively or suffer the high overhead ratio they have just been trying to avoid. The former course of action gives the company a bad reputation as an outfit with which to work and makes future recruitment of outstanding men more difficult. The latter course makes equity holders unhappy, to put it mildly.

Use of management consultants can eliminate or minimize this problem. They can be employed at any point in the cycle for whatever period they are needed. Trained and capable teams are available on a timely basis. This practice permits a cost flexibility otherwise impossible or difficult of attainment.

Secondly - progressive managements have determined that certain staff services found worthwhile in other industries are very valuable to mining. But it has not been found as yet possible in all cases to develop them as fully in mining as elsewhere. Undoubtedly, most of this is caused by the problems of the cycle of swings, which was mentioned previously. But part, also, is due to the size of the business units in the mining industry, which makes it difficult for even the larger ones to finance the staffs and the programs through all the learning and research phases. However, these functions of planning, of research and of control may well be the very factors necessary to give both the company and the industry a competitive advantage. This seeming dilemma disappears for those who find in the services of management consultants the developed knowledge, experience and techniques ready for application.

Company-Wide Problems Sometimes Difficult to Solve Internally

Thirdly—the corporate offices, the sales offices and the operating loca-

tions of mining companies generally are separated and widely dispersed. This poses many communications and management difficulties, but the one in which we are interested at this point involves the difficulty of arriving at the solution of certain major, company-wide problems which cut across more than one functional area and across more than one geographical location. By very definition as a problem, you infer disagreement as to the proper course of action to take to meet the encountered difficulty. So, if the assignment is made to a member of the sales, or of the operations, or of the accounting division to study and propose a solution involving all of them, the probability of reaction from other units may range from downright hostility to outspoken unacceptance.

Even the president cannot resolve some of these problems satisfactorily. Even if he had the time, he would have great difficulty penetrating through the claims and the counterclaims to gain the objective facts upon which to base a sound decision. Solution by committee is likely to arrive at a compromise rather than an integration. The very objectivity of a properly selected management consultant, which is discussed later in more detail, goes far toward an acceptance of that solution which is in the best total interests of the company.

A Means to Broaden Executive Development

Fourthly—a characteristic of mining is the present and prospective shortage of managerial material for the perpetuation of the enterprises. While this problem is shared by most industries, mining is particularly faced with it.

The best way to obtain executives, of course, is to develop them from within. But with the need for low overhead, mining companies cannot afford to have many of those organizational positions where the next upper job can be preliminarily occupied by an executive in training. Rotation is difficult and costly. So, the operating men, the salesmen, and the finance and the control men tend to remain specialists right up to the time they are needed in general management. Geographic location often prevents access to materials and experiences for those striving for selfdevelopment. Furthermore, it is well known that at least 85 percent or more of development comes on the job.

Therefore, whether planned direct-

ly, or as a by-product result, working on solutions to problems with qualified management consultants can be a means whereby executive development can be accelerated and broadened. If there is no one in the organization who can be developed, the management consultant is in the uniquely favorable position to help find the few key additions to the management team needed to make it a winning one.

Other unique attributes of mining could be pointed out, but these four serve adequately to illustrate the frequent desirability of outside counsel.

It should be pointed out that mining shares other important characteristics with all industries in being best able to make use of management consultants.

Special Problems Deserve External Attention

There are some management problems-usually those of the chief executive and the board-which it is simply inappropriate to have handled by inside staff. A good example of this is the problem of short- and longrange executive succession. The president simply cannot receive advice on this from his vice presidents, nor can he use them to help to get the facts to help him in his decision. It is not suggested that either the president or the board delegate the right or responsibility of making the decision, but outside counsel can be invaluable. both in fact gathering and in evaluation.

Another example where only outside counsel seems appropriate is when management wishes help in appraising one or more fundamental changes in policy, practice or organi-



"It's a crack. It looked better than our production record, so I framed it."

zation which can greatly affect employes or customers. Some widely varying examples of this are new programs for executive compensation, consideration of whether to purchase or sell the properties, or consideration of new distribution methods. Qualified management consultants know how to help with these types of sensitive problems, receiving and dealing with them in professional confidence, and counseling on an implementation of the final conclusions.

We need not proceed further along this particular line of analysis. The main general points have been made and may be summarized as follows:

First—mining management deserves and needs the competitive advantages it can derive from the most advanced management services and techniques.

Secondly—those services that it cannot provide effectively or economically for itself can be secured through wise use of properly qualified management consultants.

Attributes of Consultants are Numerous

Consultants, in turn, have certain attributes justifying the team-work with management. A few of them have already been inferred, but some of the important ones are:

Objectivity—to approach a problem from an independent, impartial and fresh viewpoint, unconditioned by internal loyalties, history and preconception. While any internal staff man worthy to hold a position will resist acting upon fear of retribution from any quarters not liking his results, or upon accusations of recommending alternatives that are better for his personal advancement than for the company's interests, the independent position of a professional consultant uniquely removes these real or fancied limitations upon the solution of problems.

Experience—in multiple and varied solutions to problems with many companies in many industries.

Knowledge—of the latest and most effective management skills and techniques. The consultant brings analytical ability to the task. He can cut through a maze of symptomatic problems to diagnose the basic causes of difficulty, and to weigh the advantages and disadvantages of the alternative courses of action.

Time-to work uninterruptedly, and on schedule, to a solution free

from the distracting day-to-day operating responsibilities that face the executives for whom he works.

Perspective—to see all aspects of a problem and to recognize correctly the interrelationships involved.

Understanding—to solicit, absorb, evaluate and integrate the thinking on problems by those experienced in the business, to receive and protect their confidences, and to extract from all this complex of fact and opinion constructive suggestions for the benefit of the company as a whole.

What Types of Services are Available?

Let's turn to examination of some typical specific services of consultants. To attempt in the available space to itemize in detail all the services available from management consultants would be like cataloging all of the problems and the functions of management. It would be safe to say that today there is effective assistance to be had on any type of problem on which management wants or needs help.

Any individual, group of individuals, or firms may offer consulting services, and there are literally thousands of them. It is impossible to speak in other than generalities about the large number that compose this group; but as with the medium and larger firms, personal interviews and checks on their references provide the best guides as to their capabilities.

The medium and the large firms are more capable of specific definition and description. A handful of the very largest, reputable firms might well be called the "department stores of management consulting" because they offer general management counsel on top or company-wide problems as well as in specialized depth in such matters as operations, sales, finance and accounting, personnel, and engineering and research. Under these classifications are as many sub-classifications as there are related business problems. Other medium and large firms follow either the pattern just described, or frequently select a functional field or even a specialty within the functional field in which to concentrate.

Types of Projects Undertaken

Within these descriptions, and in view of the confidential nature of consulting work, it will be perceived that when one attempts to become specific, it is necessary to speak within the context of experience. Consequently,

the writer hopes he will be forgiven for this one reference to experience of his firm. In working with its mining clients, major projects have included those under the following headings:

General management. Organization surveys and top organization planning, executive appraisal and development, executive compensation, and executive procurement.

Operations. A great deal of work in industrial engineering, including the organization of the function, as well as specific work in methods and standards and in cost reduction and cost control.

Sales. A wide variety of services in the field of market studies, in the setting of potentials, quotas, territories and branch locations, and, of course, sales compensation.

Engineering and research. A wide variety of services, dealing mostly with the organization, administration and control of the function.

Personnel. Wage and salary administration programs, job evaluation

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and job descriptions and many kinds of extra compensation programs.

Management consultants are not miracle men and they don't achieve results solely in their own capacity. The results come from successful and progressive managements who see in the services of qualified management consultants resources of unique values to them; they engage them to assist in a teamwork relationship, and the combination is effective.

In conclusion: managements of mining companies are in a particularly favorable position to capitalize upon the use of management consultants.

Management consultants are supplements to management, and are not replacements of them. Progressive managements use them in a teamwork relationship.

Qualified management consultants can help good managements do a better job for their companies, their stockholders, their employes and their customers.

Management deserves the final credit for the results accomplished, for they are the ones who take the risk and make the decisions.



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HOUDAILLE Construction Materials, Inc., a subsidiary of Houdaille Industries, Inc., operates five quarries in the State of New Jersey. All quarry basalt trap rock producing specification aggregate for use in construction and maintenance of highways and structures, becoming an ingredient of portland cement concrete, bituminous concrete, or specification fills and base courses.

All but one of the quarries are located in densely populated areas. All locations are governed by strict zoning laws. Only one of the quarries which, of course, is the smallest and only one located in the country, so to speak, is under a zoning ordinance properly zoned for quarrying. All the others actually operate under a nonconforming use of the zoning designation.

As can well be imagined, making primary blasts of up to 14,000 lb of dynamite, the company has to exert every precaution to make its presence as a user of relatively large amounts of high explosives as inconspicuous as possible. Vibrations created by blasting operations are the cause of complaints by its neighbors.

Types of Earthborn Waves Described

At this point it is worthwhile to briefly review the common types of vibrations we create. A vibration is a vibratory motion in the form of waves that transmit energy through a medium from the source to the spot of detection. Earthborn waves, such as those that are created in blasting, are of two general classes: (a) Body waves which travel through the interior of the earth mass, and (b) surface waves which travel only along the surface. At present there are two known types of body waves and four types of surface waves.

Of the body waves, the first is a compression wave. As it progresses, it causes a particle in its path to move back and forth along the path of advance referred to as the longitudinal direction. It is mathematically described by the number of movements per second as being its frequency and the distance between regions of compression as its wave length.

The second type of body wave is a shear wave. In this type of vibration, the particles move at right angles to the direction of the wave or in the transverse direction. The particles are actually displaced in a shearing action without compressing or changing the volume of the material. The compression wave in water is the concussion of an underwater



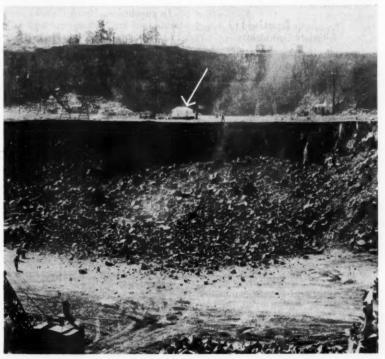
BLASTING VIBRATIONS in Quarry Operations

By DANIEL J. MILLER, JR. Chief Engineer Houdaille Construction Materials, Inc.

Troubled by complaints resulting from quarry blasting, Houdaille Construction Materials exerts every precaution to make its presence as inconspicuous as possible

Results of a nine-hole shot at the Millington, N. J., quarry of Houdaille Construction Materials, Inc. In this shot, 14,000 tons of rock were blasted using electric millisecond delay caps and 3025 lb of dynamite at a ratio of 4.29 to 1. The greenhouse in the center of the pictures, situated only 48 ft from the blast, was completely unaffected.





explosion and in air is ordinary sound. The shear wave cannot travel in either a liquid or gas because it requires resistance to shear in order to exist. However, both types travel in any solid elastic medium such as earth.

Surface waves are described as follows:

Rayleigh wave. Best described as being similar to the wave caused by dropping a pebble in calm water. A particle in the wave path has elliptical motion in a direction towards the source.

Love wave. A surface shear wave with a particle moving in a horizontal plane at right angles to the direction of the wave travel. It exists in a relatively shallow surface zone.

Coupled wave. Essentially a compound of compression and shear motion in a manner that a particle moves along a diagonal of a rectangular frame facing in the direction of the wave travel.

Hydrodynamic wave. Causes a particle in its path to move in a curved orbit similar to the Rayleigh wave except that at the top of its orbit it moves forward as a wave in water. The motion is in a vertical plane oriented in the direction of the wave travel.

Concussion from Blasting Brings Complaints

In addition to these elastic waves in earth, a quarry blast causes a concussion in the air. This is our greatest cause of neighborhood complaints. The concussion created is a compressional wave in the air and is independent of the sound wave which carries the noise.

Houdaille, like many other companies in the past, used to "load-forbear." The only thought was to get as much tonnage of rock per pound of powder as possible. The more that the rock could be shattered to finished sizes, the less work the crushing mill would have to do. It was a common joke for the blasting foreman to ask "Boys, what size do you need today—1½ in., ¾ in. or ¾ in.?"

However, it wasn't too long before local municipalities, with the advent of zoning laws and pressure at the state level, brought about the enactment of rules and regulations governing quarry blasting.

These rules and regulations specifically spell out all blasting procedures and specify a definite relationship between frequency of ground motion and cycles per second and maximum amplitude. They also specify a definite quantity distance table and limit the quarry operator to an Energy Ratio of one. They require submission to the Bureau of Engineering

and Safety of complete data for each blast. This includes a plan of the holes, a vertical sketch with the loading of each hole, complete loading data, temperature, weather results of the blast, tonnage, seismograph films with complete descriptions of their location, vibration displacements and frequencies and energy ratio computations.

With the advent of these State regulations and the realization that we would have to be a good neighbor in order to continue to stay in business, Houdaille hired a blasting consultant, Dr. L. Don Leet of Harvard University, to help set up a program of proper blasting procedure and the necessary recording data.

Seismographs Used to Check Energy Ratios

The company owns five Leet threecomponent seismographs and uses three or more for every blast. The engineering field crew spends more than 60 percent of its time either laying out holes, computing burden and blasting requirements, plotting face development and preparing the necessary data for the State.

In spite of what is thought to be a very modern open pit quarry blasting procedure, complaints are still received from nearby neighbors. These range from complaints of cracked plaster to broken tea cups.

Considerable study, research, inquiries and patience have led us to believe that air blast is the culprit that is at the bottom of our complaint troubles. Our seismograph data definitely prove that ground vibrations are far below an energy ratio necessary to do physical damage. The ratio of six is generally considered approaching the danger zone of possible damage. Three is considered safe by many authorities. The State of New Jersey requires ratios not to exceed one and our seismograph records prove we only produce ratios in tenths and hundredths.

Actual Problem is Psychological

New York Trap Rock Corp. has probably pioneered the effort that most stone quarries today make to keep air blast problems to a minimum. The actual problem is psychological rather than physical. The U. S. Bureau of Mines has published test information that pressures of one or more pounds per square inch are required to break ordinary glass. Our blasts only produce air concussion in the range of one to two hundredths of a pound per square inch. However, this is in the nature of a good puff

of wind and accompanied with noise, particularly when unsuspected, creates havoc in the minds of many individuals.

It is a well known fact that weather conditions greatly affect the direction and intensity of air blast. Normally atmospheric temperature cools as altitude increases at the rate of three to four degrees per thousand feet. If there is no change in temperature, an isotherm exists. In certain cases an inversion exists in which the temperature actually becomes warmer. When these conditions occur, the air blast, instead of dissipating in the atmosphere, can be deflected and literally bounce back to startle unsuspecting neighbors.

We have set up a service with a meteorological company to give us daily forecasts of the isotherm and inversion conditions, and an associated condition known as wind shear, for our plants. They can predict a trend 36 hours ahead. This is corrected with greater accuracy as the time for shooting approaches. There are times, for obvious reasons, when loading and shooting cannot be delaved. However, to be forewarned is to be forearmed and by knowing the atmospheric conditions we can reasonably predict the air blast effects and alleviate the element of surprise by a prior phone call.

In summary, when blasting is done in a populated area, the ground and air vibrations that are created will cause complaints.

Procedures Developed to Alleviate Complaints

Ground vibrations can be easily kept way below any possible damaging displacement and frequency by modern blasting techniques. Air blast can be controlled by timing blasts with proper weather conditions.

The procedures we have tried and which we believe have been of help in alleviating complaint problems are as follows:

- Hired the services of a top-notch blasting consultant to review procedures, testify and give demonstrations of what actually occurs when we blast.
- 2. Use millisecond delay electric blasting caps. No Primacord is used except in the case of the Bound Brook operation where it is placed within the hole itself to connect the 2nd and 3rd deck as an added assurance of detonation. Except in shallow holes, the zero cap is in the bottom and first delay in the top deck.
- 3. The company's engineering field crew lays out hole centers and

accurately computes burdens by measurements. As a result, the proper ratios established over years give the correct amount of powder required. It has been found that too little powder can cause far more trouble than the proper amount.

- 4. For a period of time we shot level with the quarry floor but have changed procedure and find better seismograph results by shooting in the range of two to six ft below floor level, depending on the particular quarry.
- Take seismograph records of all blasts, even going so far as to record in the houses of chronic complainers.
- Show movies and give demonstrations of blasts to interested groups to educate and relieve fears of ignorance.
- At one plant, the blast is set off when the local freight train goes by.
- Follow up with a personal contact as soon as possible after each complaint.
- Forewarn certain individuals with a phone call as to time of shooting.
- 10. At two quarries, the company has erected glass greenhouses as close as 100 yd to the operating face. To date not a single pane of glass has been broken. This is a good tool to show people who are skeptical of the claim that the company's blasting has no damaging effects.

In conclusion, Houdaille's blasting techniques are both correct and safe. The company is equipped with evidence to prove beyond doubt to anyone that this is true. The biggest problem is to convince our neighbors that we create no more damage than a passing freight train or good puff of wind.



"I got turned around back there some-



As Viewed by HENRY I. DWORSHAK of the American Mining Congress

CONGRESS usually takes its time in acting on Presidential requests for legislation, but on occasion it can move with celerity. Less than a fortnight after President Kennedy's address to the Nation on the Berlin crisis, it had approved two bills authorizing expenditure of an additional \$4.5 billion to bulwark the national defense.

The Berlin crisis also might smooth the rocky path of the Administration's Foreign Aid bill through the legislative mill. Biggest bone of contention with respect to this measure is that it calls for direct borrowing of \$8.8 billion from the Treasury over a five year period, rather than having the program depend upon annual Congressional appropriations.

Still undetermined is the effect the crisis will have on the tax bill which the House Ways and Means Committee has been working on for months. This involves an investment credit aimed at spurring modernization and expansion of industrial plants, coupled with the closing of so-called "loopholes" to offset the loss of tax revenue. With adjournment of Congress expected next month, it appears that time is running out for passage of any major tax legislation this year.

SUBCOMMITTEE APPROVES BILL FOR MINE SAFETY STUDY

A House Labor subcommittee has reported to the full Committee a bill calling for a two-year study of safety and health conditions in metal and nonmetallic mines, as a basis for determining whether regular Federal inspection of these mines is necessary.

Subcommittee action came after Interior Secretary Stewart L. Udall had suggested approval of a measure of this type, in lieu of a bill by Rep. O'Hara (Dem., Mich.) which would provide for Federal inspections of noncoal mines on a permanent basis.

At earlier hearings, mining industry spokesmen voiced unanimous opposition to the O'Hara bill—on the

WASHINGTON HIGHLIGHTS

CONGRESS: Extra defense funds rapidly authorized

MINE SAFETY: Bill provides for two-year study

STOCKPILES: Use in foreign aid program scrapped HANFORD REACTOR: In contro-

versy

LEAD-ZINC: Higher tariffs opposed by Administration

posed by Administration
WILDERNESS BILL: Gets Committee approval

RESIDUÁL OIL: Coal industry continues fight WATER POLLUTION: Bill is signed

by President

basis that such inspections would merely duplicate the activities of State and local inspectors and would contribute little if anything to safety and health in the Nation's mines. They also pointed to the excellent job that mine management and unions are doing in this field.

Mining witnesses included Julian Conover, executive vice president, American Mining Congress; Miles P. Romney, manager, Utah Mining Association; Langan W. Swent, Homestake-Sapin Partners, Grants, N. M.; Al Kolu, Pickands Mather & Co., Duluth; G. A. Borgeson, The M. A. Hanna Co., Hibbing; R. F. Wilson, Oliver Iron Mining Division, U. S. Steel Corp., Duluth; and A. J. Teske, secretary, Idaho Mining Association.

Udall later wrote to Conover that, at the end of the proposed study, "we will submit recommendations to the Congress for a well-rounded program to serve the noncoal mining industries."

STOCKPILE SECTION DELETED FROM FOREIGN AID BILL

The Administration's Foreign Aid bill, as introduced earlier this year, contained a precedent-shattering Sec-

tion 609 which would have authorized the use of strategic and critical materials from Government stockpiles in providing economic assistance to other countries, but this section was eliminated from the measure before it reached the floor of either Senate or House.

Under this proposal, each release of stockpile materials would have become effective after only 60 days' notice unless Congress disapproved it within that period—a dangerous weakening of the laws safeguarding the stockpiles.

In letters to the Senate and House Committees handling the Foreign Aid bill, the American Mining Congress urged that Section 609 be eliminated. The AMC emphasized that it failed to provide adequate protection against disruption of markets and would have an extremely unsettling effect on the whole structure of free-world metal and mineral markets and on the domestic mining industry.

After their Committees had deleted the section, Chairman Fulbright (Dem., Ark.) of the Senate Committee and Chairman Morgan (Dem., Pa.) of the House Committee sent letters to Julian Conover, AMC executive vice president, advising him of this action.

HOT FIGHT OVER HANFORD POWER PROJECT

A proposal to construct a \$95 million project at the Hanford, Wash., nuclear reactor, to produce electric energy for commercial use, was contained in the annual AEC authorization bill, and at this writing is the subject of hot debate. The provision for the power project was approved by the Joint Committee on Atomic Energy, but was eliminated from the bill during House consideration. The Senate restored the authorization and sent the bill as amended back to the House. This started a House fight over naming conferees to work out the final version.

Customarily, when such legislation

is received from the Senate, the House gives unanimous consent to the appointment of conferees, and the bill is referred directly to the conference committee. In this case, opponents of the Hanford project refused unanimous consent: the matter was referred to the Rules Committee and will now be subject to further debate on the House floor, during which a motion will be in order to instruct the House conferees to insist that the Hanford project be deleted from the

Spokesmen for the coal and private power industries have objected vigorously to inclusion of the Hanford project, pointing out that it would amount to Government subsidy at high cost of a competitive source of energy, and, with the creation of a large power reserve in the Northwest, would lead to pressure for the construction of connections with other power grids, and ultimately to the "spread-eagling" of the country with "gigantic Federally subsidized public power systems.

ADMINISTRATION OPPOSES HIGHER LEAD-ZINC TARIFFS

Two Government officials have advised the Senate Interior Committee that the Administration "is simply not ready to concede" that restrictive tariffs or production subsidies are the only answer to the problems of the depressed lead-zinc industry.

The spokesmen were John M. Kelly, Assistant Secretary of Interior for Mineral Resources, and Michael Blumenthal, a Deputy Assistant Secretary of State. They appeared before the Committee in opposition to the Anderson-Aspinall bill, which would place import taxes on lead and zinc metal, ores and concentrates-at rates somewhat higher than present tariff duties-and double the import taxes when the price of either metal is below 131/2 cents per pound. The measure would also provide for subsidies on domestic production of lead and zinc covering up to 2,000 tons of each metal annually.

Both Kelly and Blumenthal based their opposition to higher duties on international considerations. countries which comprise the principal suppliers of lead and zinc to the United States are among our strongest allies," Kelly said, "and it is the considered judgment of the Administration that any weakening of the economies of these countries, or any alienation of their support, by increased protection to domestic lead and zinc mining would be adverse to the over-all national interest."

However, Kelly added, the Interior Department approves enactment of a three-year subsidy bill based on a combined price of 271/2 cents per pound, with payments limited to 750 tons of each metal the first year, 500 tons the second year, and 250 tons the third year. The Government is considering other ways to help the industry, he said, including the use of task forces to see what might be done to aid depressed mining districts and a study of the results which might accrue from the removal of limitations on the expensing of exploration costs and the possibility of permitting full percentage depletion without the present limit of 50 percent of net income.

Senator Anderson (Dem., N. M.). coauthor of the bill, expressed disappointment at the Administration's position. He indicated that he would try to push his bill through Congress despite the prospect of a Presidential veto.

Industry witnesses who outlined the need for the bill and urged its enactment were Clark L. Wilson, Lead-Zinc chairman. Emergency Committee; Miles P. Romney, manager, Utah Mining Association; A. J. Teske, secretary, Idaho Mining Association; W. F. Darmitzel, executive director, New Mexico Mining Association; and Tom Kiser, president, Tri-State Zinc-Lead Ore Producers Association.

R. A. Young, vice president, American Zinc, Lead & Smelting Co., stated that "legislation is the only practical solution" but said that the import tax rates in the Anderson bill are too high.

On the House side, the Mines and Mining Subcommittee moved swiftly after getting the Administration views. It reported to the full Interior Committee a four-year subsidy bill under which eligible miners would get payments on up to 1,500 tons each of lead and zinc the first year, 1,200 tons the second year, 900 tons the third year, and 600 tons in the final year. The subsidy would be 75 percent of the difference between what the miner actually receives and 141/2 cents per pound in the case of lead and 55 percent of the difference in the case of zinc.

SENATE COMMITTEE APPROVES WILDERNESS BILL

Despite the strong opposition of the mining and other natural-resource industries, the Senate Interior Committee has approved the Wilderness bill, and the measure may come up for a Senate vote at any time.

This measure would set aside for the exclusive use of wilderness enthusiasts an estimated 55 million acres of public land areas. It would include in this wilderness system some 15 million acres of national forest lands now subject to prospecting and development under the mining laws but which, under the bill, would be subject to special provisions that would foreclose such activity.

Four Senators-Dworshak (Rep., Idaho), Hickey (Dem., Wyo.), Goldwater (Rep., Ariz.) and Allott (Rep., Colo.) -- submitted a minority report calling attention to the fact that the bill would harm the development of the West, which contains most of the

lands involved.

The majority report ignores the explanations of the American Mining Congress, during hearings and in communications to Committee members, that the measure would effectually prevent, within the wilderness system, the modern scientific prospecting which is the first step in locating hidden mineral deposits, and would thus preclude the discovery of important mineral deposits in extensive unexplored areas which hold great geologic promise.

COAL INDUSTRY STRESSED NEED FOR RESIDUAL OIL CONTROLS

Spokesmen for the coal industry have again urged the Office of Civil and Defense Mobilization to continue and strengthen the residual oil import control program to protect the national security and welfare.

The National Coal Policy Conference, the National Coal Association and the United Mine Workers of America submitted a 60-page statement to the agency calling for this action, and the American Mining Congress has advised OCDM Director Frank B. Ellis that it concurs in the views thus presented.

In the statement, it is pointed out that increasing dependence upon foreign sources of residual oil has resulted in injury to the production and distribution capacity of the domestic fuels economy, and particularly to the bituminous coal industry.

It was emphasized that, in event of an emergency, the country's fuels requirements would rise rapidly, while supplies of imported fuel to meet these requirements would be drastically reduced; that coal would again be called on to meet the major share of this increased demand, and that unless effective measures are taken promptly to strengthen the coal in-

(Continued on p. 95)



James Hyslop has been elected a vice president of Consolidation Coal Co. He relinquishes his post as president of Consol's Hanna Coal Co. Division, and is succeeded in that post by J. D. Reilly.

Hyslop will represent Consol in the Ohio Coal Association, the Bitumi-





J. Hyslop

J. D. Reilly

nous Coal Operators Association, and the National Coal Association on safety, labor and legislation. He also will assume responsibility for a number of additional special projects on which Consol wishes to see accelerated development. He will continue to reside in St. Clairsville, Ohio, and will have his headquarters there.

Hyslop started in coal at the age of 16 in Indiana coal mines. He rose through the ranks to become general manager of one of the leading midwest coal producers. In 1940 he joined Hanna Coal Division as general manager, and later was elevated to operations vice president and then president.

Reilly started with Consol in 1942. He came to Hanna Coal in 1945 as mine superintendent, advancing to the position of general manager of underground mines, then vice president.

Willard J. LaMorte, has succeeded Thomas Bardon as president of Shattuck Denn Mining Corp. La-Morte for the past two years has been executive vice president of the company. Bardon will continue as chairman of the board.

W. A. Gallagher has been elected executive vice president of Westmoreland Coal Co. and Stonega Coke and Coal Co. He was previously vice president.

Charles M. Schloss, president of Schloss & Shubart, Inc., Denver, has been elected president of the Rocky Mountain Coal Mining Institute.

William W. Karl has been appointed vice president of Nytralite Aggregate, Inc., a newly formed subsidiary of New York Trap Rock Corp. He is former president of Lehigh Materials Co.

Thomas F. Owens has been appointed treasurer of National Lead Co. succeeding Joseph J. Morsman, Jr., who has retired. Owens has been assistant comptroller of the company since 1951, having joined it in 1934.

Joseph L. Gillson has been appointed consultant for the Engineering & Construction Division of South-

western Engineering Co. His work will be in mining and chemical processes particularly concerned with the treatment of titanium ore for recovery of titanium oxide.



In 1960, Dr. Gillson was president of AIME; he is a past president of the Society of Economic Geologists and of the American Geological Institute, a past vice president of the Mineralogical Society of America, and a Fellow of the Geological Society of America. He has taught at Harvard University and at MIT and was chief geologist with E. I. duPont de Nemours Co.

Samuel E. Sharp, director of the engineering safety department, Tennessee Copper Co., was recently one of eight individuals to be honored by being named a "Fellow" in the American Society of Safety Engineers. The group was the first ever to be selected as "Fellows" in the organization's 50-year history.

J. Richard Lucas, formerly in charge of mining engineering at Ohio State University, has been appointed head and professor, mining engineering department, Virginia Polytechnic Insti-



tute. He succeeds J. R. Lucos Charles T. Holland who has become dean of the School of Mines, West Virginia University. Lucas had been at OSU since 1954, prior to which he was a field engineer for Joy Manufacturing Co.

JOINS AMC STAFF

Chester N. Truax, Jr., formerly mining engineer with International Salt Co. at the Retsof mine, Retsof, N. Y., has joined Mining Congress Journal as assistant editor. He will also

work closely with George Sall in Coal Division activities.

Truax brings over 10 years of experience in coal, salt and metal mining, as well as in the field of mineral education, to the Ameri-



can Mining Congress and the Journal. A graduate of the University of Pittsburgh, he has done post-graduate

work at the University of Rochester and Lehigh University. The first two years of his professional career were spent as a member of the engineering staff of Allegheny Pittsburgh Coal Co. In 1952 Truax joined the faculty at Lafayette College as assistant professor of mining engineering, leaving to go with International Salt in 1955. In addition to his many other duties at Retsof, he was editor of the mine's quarterly magazine.

Truax has also worked as a miner for the New Jersey Zinc Co. and the Allen Wood Steel Co. He is a member of the American Association of University Professors, Society of Mining Engineers, AIME, and the American Society of Engineering Education.

Charles M. Romanowitz, internation ally known dredging expert, has opened a consulting office at 2034 Santa Clara Avenue, Alameda, Calif. Romanowitz has had 50 years experience in



dredge applications and operations, including 38 years with Yuba Manufacturing Co. and eight years with Natomas Co. For the past $3\frac{1}{2}$ years he has been with Ellicott Machine Corp. on a full-time basis and is now being retained as consulting engineer.

Bruce A. Keay was recently appointed assistant comptroller of U. S. Steel's Oliver Iron Mining Division, succeeding G. T. Bethune, who was earlier named comptroller. Keay started with the corporation's American Bridge Division in 1936 in the industrial engineering department.

Wayne A. McCurdy has been appointed chief of the division of mining and preparation in the Office



of Coal Research, Department of the Interior. His division will be responsible for evaluating coal research proposals involving mining technology, equipment,

processing, and preparation and also for rendering staff support to the Director, Office of Coal Research.

McCurdy was assistant editor of Mechanization Magazine from 1953 to 1955 and since 1956 has been editor of Mechanization. His mining experience has included mining engineering, industrial engineering, and various supervisory jobs with Christopher Coal Co., Mountaineer Coal Co., and Island Creek Coal Co.

S. J. McCarroll, manager, Manganese, Inc., Henderson, Nev., has been named manager of mines, Howe Sound Co. He succeeds F. A. McGonigle who recently resigned. Manganese, Inc., is a Howe Sound affiliate.

Edward J. Cole has been appointed chief engineer of Bestwall Gypsum Co. Headquartered at the company's research center in Paoli, Pa., he will be in charge of engineering for some ten gypsum plants

throughout the United States and Canada. Cole joined Bestwall in 1956 as mining engineer in charge of the company's Nova Scotia holdings.

David W. Goldsmith has joined U. S. Borax & Chemical Corp. at Boron, Calif., as senior process engineer. He was formerly associated with American Potash & Chemical Corp., Potash Co. of America, and Kaiser Aluminum & Chemical Corp.

Roland D. Parks, associate professor of mineral industry in the Geology and Geophysics Department, Massachusetts Institute of Technology, will be Fulbright Lecturer in Mining Engineering at the University of Assiut, Assiut, Egypt, during the 1961–62 academic year.

Chester O. Ensign, Jr., has been appointed chief geologist of Copper Range Co. For the past six years Ensign has been in charge of exploration projects for American Metal Climax, Inc. Earlier he was exploration supervisor for Davison Chemical Co.

T. O. Evans, general manager and chief mining engineer of Haystack Mountain Development Co., has retired. Evans was also chief mining engineer for Atchison, Topeka & Santa Fe Railway Co., Haystack's parent organization.

D. L. Hetland, project geologist in the Northwest District Office, Atomic Energy Commission, at Spokane, Wash., has been transferred to Utah, as chief of the Monticello office. David P. King, geological engineer, succeeds Hetland as project geologist at Spokane.

Robert D. Bradford of Mc-Alester Okla., district supervisor of health and safety, U. S. Bureau of Mines, has been named president of the Mine Inspectors Institute of America.

Dennis J. Keenan has been appointed a mine inspector for the 11th Bituminous District in the State of Pennsylvania succeeding the late Clarence B. Lozaw. Keenan previously was an inspector for 13 years in the 15th Bituminous District. From 1951 to 1960 he was affiliated with Sterling Coal Co.

OBITUARIES

John J. Foster, 72, vice president, public and industrial relations for Island Creek Coal Co. until his retirement in February, died July 15 at Huntington, W. Va.



Born in Lewiston,
W. Va., Mr. Foster graduated from
Marshall University in 1908 and immediately commenced the long and
prominent career which endeared him
to Island Creek Coal Co. and the coal
industry in general. He began as a
clerk and advanced to general manager of operations at the mining
properties of the company in Holden,
W. Va. He was transferred to Huntington in 1948 as assistant to the president, and in 1952 was elected vice
president-public and industrial relations.

Mr. Foster was a director and active member of various industry and civic organizations. In recognition of his many public and industry services, the National Guard Armory at Monaville, W. Va., which was dedicated in January of this year, was named in his honor.

Arthur Notman, 78, consulting mining engineer and geologist, died July 19 in New York City.

Mr. Notman was a mining engineer and geologist with Phelps Dodge Corp. in Arizona from 1908 to 1917. In 1917, he became assistant general manager for the company at Bisbee and later became general manager. Mr. Notman left Phelps Dodge in 1923 to become a consultant. He was a director of Magma Copper Co., San Manuel Copper Co., New Jersey Co., Campbell Chibougamau Mines Ltd. and Chibougamau Mines & Smelting Co. and president of Berde Exploration Ltd.

R. M. Davis, coal operator, philanthropist and world-peace advocate, 79, died June 26.

Before his retirement in 1956, Mr. Davis was active for many years in the coal industry of West Virginia. He had controlling interest in the Davis Wilson Coal Co., the Bunker Coal Co., and the Chapin Collieries Coal Co.

Frank R. Amos, 71, retired vice president and general counsel of Consolidation Coal Co., died in Fairmont, W. Va., on May 30.





Cleveland-Cliffs Building Big Sawmill in Michigan

Construction of a major sawmill. the first to be built in the Munising area of Michigan since before World War II, has been started by the Cleveland-Cliffs Iron Co.

The new mill, which will process timber now growing on some 350,000 acres of company land, is situated eight miles east of Munising at the Hartho Spur of the Lake Superior and Ishpeming Railroad. It will operate initially at a production rate of 14.000,000 board ft of high quality northern hardwood lumber-it will process soft timber at some future date. Some 50 employes will eventually man the plant which is scheduled for completion early in 1962.

The mill is to be directed by Clifford P. James, manager of the Forest Products Division of the company, with headquarters in Cleveland.

Eastern Gas May Acquire **Barge Line**

The managements of Eastern Gas & Fuel Associates and Midland Enterprises, Inc., have reached an agreement for the acquisition by Eastern Gas of the assets of Midland on the basis of an exchange of 11/4 shares of Eastern common stock for one share of Midland stock.

Midland is a New York corporation whose wholly owned subsidiary, The Ohio River Co., is a major carrier of inland waterborne tonnage in the United States. Through joint service and tariffs with other barge lines, Ohio River Co. provides river transportation service throughout the entire Mississippi River system.

Consummation of the proposal remains subject to the execution of the final agreement and approval by the shareholders of both companies and by any necessary governmental au-

thority.

Pea Ridge Project To Be in Production by Mid-1963

Meramec Mining Company's huge Pea Ridge iron mining project near Sullivan, Mo., is expected to be in full production by the middle of 1963. The \$40,000,000 project is a combined venture by St. Joseph Lead Co. and Bethlehem Steel Co.

Two shafts of 19-ft, finished diam have been sunk to levels below 2000 ft. Many new permanent structures of brick and galvanized siding have been erected, replacing temporary quarters, and a new railroad line of 26.7 miles has reached the mine site.

Bethlehem Steel will design and construct the ore processing plant, which will refine the ore and pelletize it.

The mining company expects to market about 2,000,000 tons of pellets a year when the plant starts production in 1963. This means processing between 10,000 to 12,000 tpd of

Peabody Begins Scholarship Program

Peabody Coal Co. has announced that it plans to participate in a Cooperative Training Program which will enable a number of deserving sons of Peabody employes to attend the School of Mines and Metallurgy of the University of Missouri, Rolla, Mo. The program is restricted to sons of Peabody employes and is designed for families who require financial assistance in meeting educational ex-

Under the plan, students will get practical experience working in the company's mines as well as the formal training provided by the University.

The company has called on its mine superintendents to confer with high school principals and with young men they feel deserve consideration as candidates. Final selection will be made by a committee appointed for that purpose.

The company hopes to select two students who will qualify to commence their training under this program in the Fall of 1961.

Natural Resources and the Department of the Interior

A staff report, Planning, Policy Making and Research Activities—U.S. Department of the Interior, has been published by Resources for the Future.

The study was made at the request of Secretary of the Interior, Stewart

(Contined on next page)

Honorary Degree Given Overstreet

On June 4, 1961, Roanoke College conferred the honorary degree of doctor of laws upon J. W. Overstreet,

president, National Electric Coil Division, McGraw-Edison Co. The citation read on this occasion said in part, "Under your imaginative and forceful leadership this company (National Electric Coil Co.) became interna-



tionally known as one of the outstanding organizations of its kind, with sales in practically every free nation of the world. . . .you are one of the leading industrialists in the middle western states of this great nation, and your accomplishments are well known throughout industry in general, both in the domestic and foreign fields."

"Red" Overstreet has long been associated with the American Mining Congress, serving on the Board of Governors of its Manufacturers Division for several years. He also served as chairman of the division in 1955.

L. Udall. It deals only with resources aspects of the Department's work and is concerned primarily with the role of the Secretary and other presidentially appointed officials in developing and coordinating research, planning and policy making. As background to the analysis the report includes a brief survey of natural re-

sources problems of the 1960's.

The 44-page, paper-bound report is available from Resources for the Future, Inc., 1775 Massachusetts Ave., N. W., Washington 6, D.C., at 50 cents a copy.

TVA Purchases Coal Reserves

Tennessee Valley Authority for the first time in its history has purchased coal reserves in the ground. The coal industry's largest single customer has exercised an option to buy mineral rights on 59,000 acres of coal land in southeastern Kentucky, and obtained an additional option for coal rights on 53,000 acres in Tennessee. The reserves were purchased, it is said, to help insure an adequate long-range fuel supply for the Government agency.

Iron Ore Activity in Quebec

The Jubilee Iron Corp., a subsidiary of Canadian Javelin Ltd., has taken an option to manage and operate the Ironside iron ore property, located two miles outside of Hull, Ouebec.

It is reported that more than \$1,-800,000 has already been spent on the Ironside property, preparing shafts, access tunnels and galleries, purchasing equipment and preparing the deposit for production.

There is an additional option which includes an arrangement for the Jubilee Iron Corp. to manage, develop and exploit the Laussedat Township iron ore properties in Quebec, owned

by the Quebec South Shore Steel Corp. (Quesco). This deposit is strategically located, in that it is immediately adjacent to the railhead of the United States Steel Corporation's Cartier Railway, recently completed to serve the neighboring Lake Jeannine iron ore concentrating plant of U. S. Steel.

Pursglove Receives BCR Award

The 1961 BCR Annual Award for outstanding leadership on behalf of industry-sponsored coal research was recently presented to Joseph Pursglove, Jr., vice president, Consolida-tion Coal Co. Pursglove, who has been vice president of research and development of Consolidation since February 1947, is responsible for the largest research program ever undertaken by a single coal company. It involves research into economical methods of converting coal into chemicals, special carbons, gaseous and liquid fuels, and the pipelining of coal to markets. With a technical staff of about 160 and a new research center, the work of the company in these fields has attained international attention.

President's Conference on Occupational Safety Set for March 1962

President John F. Kennedy has set March 6-8, 1962, as the dates for the next biennial meeting of the President's Conference on Occupational Safety. He named Secretary of Labor

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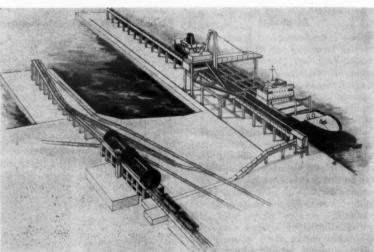
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Consulting Mining Engineers

Modern Mining Systems and Designs Foreign and Domestic Mining Reports HENRY W. OLIVER BLDG. Pittsburgh, Penna. THE NORFOLK & WESTERN RAILWAYS' coal pier, which is now being designed, will be the largest and fastest in the world. It will include a high-speed rotary cardumper system, a 96-in. wide conveyor belt system, and

a 10,000 tph traveling shiploader. The project is expected to be completed next year and will be capable of dumping 126 rail cars of coal every hour.



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Arthur J. Goldberg as general chairman of the Conference.

In calling the Conference, the President said: "The purpose of the 1962 Safety Conference will be to re-energize and expand our efforts to reduce on-the-job deaths and injuries. Despite more than a generation of organized safety work, 13,800 workers were killed last year in job accidents. There were also nearly 2,000,000 disabling injuries. This toll must be reduced. Since new technology constantly changes methods of work. we must continuously improve our safety antiques to keep pace with rapid industrial progress. This is the challenge which will face the President's Conference on Occupational Safety when it meets next year."

Russian Versus U. S. Coal in Europe

A leading Italian industrialist recently said that the European Coal and Steel Community would promote a major Russian victory in the cold war if it gives Russia and America the same chance to sell coal in Europe.

Count Casimiro Sas Kulczycki, director of purchases, Societa Edisonvolta, of Milan, Italy, told the 16th annual luncheon of the Coal Exporters of the United States, Inc., that the placing of America and Russia on the same trade level in Europe would be "grotesque," since Russia is tradeing her raw materials for machine tools instead of finished products so she can soon undersell the free world in manufactured goods and thus create more unemployment and opportunities for Communism. Thus, he said, once again Russia will have won a major victory in the cold war. To prevent this, Count Kulczycki

To prevent this, Count Kulczycki urged Europe and America to "unite and collaborate as closely as possible" in all fields and in coal trade relations to prevent Russia, China and other Communist countries "from further increasing their already considerable strength."

Single Producer of Hollow Drill Steel Left in U. S.

With the report that Bethlehem Steel Co. is discontinuing production of hollow drill steel, Crucible Steel Co. of America will be left as the only domestic producer. Bethlehem has notified major distributors that it will no longer manufacture the product. The domestic industry has in recent years been in strong competition for this market with foreign

manufacturers who are now estimated to be supplying about 30 percent of the total volume. Crucible has made hollow drill steel for 50 years and is in a position to supply the entire domestic demand. The company is currently investing in new equipment to maintain the quality of its hollow drill steel for the mining industry.

Joy Realigning Manufacturing Plants

Joy Manufacturing Co. plans to expand some of its larger facilities, re-

locate several activities, and close two small plants. These steps are being taken as the final phase of a two-year program to achieve greater operating efficiencies by consolidating operations at fewer locations. This phase of the program will involve expenditures of over \$3,000,000 for buildings and machinery.

The Coal Machinery Division's engineering center at Franklin, Pa., will be expanded by new construction of

(Continued on page 94)



approximately 20,000 sq ft of additional office building for housing approximately 200 engineering personnel. Approximately 30,000 sq ft of manufacturing space will also be constructed at Franklin.

The manufacturing and engineering activities of Compton, Inc., a subsidiary of Joy, will be moved from Clarksburg, W. Va., to Franklin, and the Clarksburg facility will be offered for sale.

The increase in engineering and plant facilities at Franklin will also permit the Coal Machinery Division's conveyor department to be moved from New Philadelphia, Ohio, to Franklin.

The space thus made available at New Philadelphia, plus a 35,000 sq ft expansion, will permit the company's Electrical Products Division to move from St. Louis to New Philadelphia. The St. Louis plant will then be offered for sale.

Production at Claremont, N. H., will be increased by the addition of gear and chain manufacturing. Last January Joy acquired the machinery and equipment of the Gear Division of Ohio Forge & Machine Corp. of Cleveland. This equipment is now transferred to Claremont. On June 2, Joy's chain plant at Franklin was destroyed by fire and chain manufacturing will be established in Claremont.

Morrocco Looking at Phosphate Rock Drying Process Utilizing Nuclear Fuel

L'Office Cherifien des Phosphates (OCP), the Moroccan governmentowned agency, has engaged Dorr-Oliver Inc. of Stamford, Conn., to study the feasibility of a new phosphate rock drying process together with the possible use of nuclear power as a fuel source. Burns & Roe, Inc., of New York City and Arthur V. Peterson Association of Westport, Conn., will work with Dorr-Oliver's project engineering group on the nuclear aspects of the project.

aspects of the project.

As part of OCP's plans for expansion and modernization of Morocco's phosphate industry, the study will establish the economic and process feasibility of the new drying technique which has already been operated at OCP's Khouribga operation on a pilot plant scale. Utilizing the vapor recompression principle, the process requires substantial volumes of steam as fuel. This load factor, together with Morocco's relatively high fuel costs, indicates that nuclear

power may be economically competi-

Sufficient engineering, design and cost data will be developed to enable OCP to make its decision on commercial exploitation by the year end.

Cement From Mine Tailings and Shale

A Canadian research group, Ontario Research Foundation, has suggested that shale deposits of southern Ontario and mine tailings from northern Ontario can be used to manufacture "pozzuolans"—types of cement that make excellent mortars, concretes, and masonry units. Techniques for treating shale and mine tailings to develop high pozzuolanic activity have been demonstrated by ORF, and the Foundation hopes to continue its investigation with a study of the economic potential for a pozzuolan industry.

In ancient Rome the most durable mortars were made from simple mixtures of lime, volcanic ash and sand. These mortars were characteristically slow in hardening, but eventually achieved considerable strength. One preferred source of volcanic ash was on the Island of Pozzuoli-hence the name pozzuolan. This material has been used in North America to confer useful qualities to portland concretes. In certain European countries, however, pozzuolans are more widely used. In Sweden, for example, two types of lightweight pozzuolanic building materials account for virtually all concrete masonry.

ALSO . . .

New York Trap Rock Corp., one of the largest crushed stone producers in the nation, has entered the lightweight aggregate field. It expects to be serving the New York metropolitan area with a high grade structural lightweight aggregate by the spring of 1962. A new \$2,000,000 plant will be constructed on Rondout Creek in the Town of Ulster, N. Y., where a subsidiary company will produce the aggregate at an anticipated production rate of 500,000 cu yd per year. President of the lightweight aggregate operation is Paul M. Hedley, former vice president of North American Cement Corp.

By 1964 the Southern Co., a utility holding concern, estimates its operating units will increase their coal use by 65 percent over 1960, while cutting back 47 percent of natural gas consumption. Detroit Edison Co.,

which already uses coal for practically all of its power generation, expects to burn 7,279,000 tons of this solid fuel in 1965, up nearly 28 percent from the 5,720,000 tons burned last year.

McNally - Pittsburgh Manufacturing Corp. has gained controlling interest in the Kennedy Van Saun Manufacturing & Engineering Corp. Kennedy Van Saun is prominent in the manufacture of cement making equipment and equipment for crushing and processing metal and non metallic minerals.

Island Creek Coal Co. reopened its Mine #22 July 10, at an initial production rate of 1000 tpd. The mine is located at Pine Creek, W. Va.

Dravo Corp. has added a versatile test facility for iron ore pelletizing research to its Research Center on Neville Island near Pittsburgh, Pa. The addition supplements existing equipment already being utilized to run tests of pelletizing and other agglomeration processes on a variety of materials, including zinc, lead, bauxite, cement, phosphate, and fly ash. Expansion of the company's facilities was considered essential in view of estimates that 25,000,000 tons of pelletizing capacity will be constructed within the next ten years.

Southern Coal & Coke Co. has been awarded a contract to furnish TVA with 339,000 tons of coal during 1961. All of this coal will come from mines in Campbell County, Tenn., and Whitley County, Ky. Most of it is scheduled for TVA's Kingston steam plant.

In late June St. Joseph Lead Co. sold its entire interest in stock and income bonds of Brunswick Mining and Smelting Corp., Ltd., to a Canadian investment company.

Book Reviews

Dictionary of Mechanical Engineering, by Alfred Del Vecchio, Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. 346 p., \$6.00.

This comprehensive dictionary and sourcebook presents prime definitions in the fields of architecture, automatic controls, engineering mechanics, fuels and combustion, power plants, along with related definitions in basic electricity, heat treatment of metals, basic mathematics and welding. It will be useful for engineering students and teachers, as well as skilled workers in the fields covered. WHEELS OF GOVERNMENT (continued from page 88)

dustry, the security of the Nation will be greatly impaired.

The coal industry statement was presented in connection with a current OCDM study of the residual oil import program.

WATER POLLUTION BILL SIGNED BY PRESIDENT

President Kennedy has signed into law a bill which greatly broadens the Federal Government's powers under the Federal Water Pollution Control Act.

Sponsored by Rep. Blatnik (Dem., Minn.), the new law (1) extends Federal authority to secure abatement to all navigable waters, whether or not there is a showing of interstate pollution; (2) transfers the Act's administration from the Surgeon General to the Secretary of Health, Education and Welfare; (3) authorizes sharply increased Federal financial participation in water pollution control projects, and (4) permits the Secretary of H-E-W, with the consent of the Governor, to seek Federal court action to secure abatement of pollution which affects only the State in which it occurs.

The new law does not contain a provision of the original Blatnik bill which would have empowered the Secretary to issue final abatement orders.

ALSO EASTERN NEWS AND VIEWS . . .

Many of the accomplishments and problems of the United States coal industry, from both technical and economic standpoints, will furnish the themes of the 24th Annual Joint Solid Fuels Conference to be held October 5–7, in Birmingham, Ala. Sponsored by AIME and American Society of Mechanical Engineers, the Conference will take up the preparation of coal for various markets, the use of a number of types of equipment, application of computers, coal reserves, and other phases of the industry.



Old Timers Award

GEORGE ANDREW OWENS, JR., has been given the Old Timers award at Virginia Polytechnic Institute, Blacksburg, Va. Owens attended VPI on a co-opprogram and made an outstanding record. He has been employed by Island Creek Coal Co.

Consolidation Coal Co. has leased more than 20,000,000 tons of coal reserves near the Ohio River south of Wheeling, W. Va., from Lorain Coal & Dock Co.

Superior Pocahontas Mining Co., Inc., has bought the physical assets and leased the mining rights of two mines at Capels and Havco in McDough County, W. Va. The mines were previously operated by New River & Pocahontas Consolidated Coal Co. It is reported that the lease involves about 80,000,000 tons of low-volatile metallurgical coal.



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Record U. S. Production of U₃O₈ in 1960

Domestic uranium concentrates from 25 mills in 1960 amounted to about 17,650 tons of U_aO_8 , a record production comparing with 16,390 tons produced in 1959. Imports by the U. S. in 1960 totaled 15,770 tons of U_aO_8 of which 11,310 tons came from Canada. The balance was imported from Australia, Belgium, Republic of the Congo, Portugal, and the Union of South Africa. Freeworld production of uranium in 1960 was placed at about 41,000 tons.

Fifteen of the 26 domestic uranium processing mills have signed extended uranium concentrate procurement contracts with the Atomic Energy Commission for the 1962–66 period. The remaining 11 contracts are under review. After March 1962, a price of \$8.00 per pound of U₃O₈ will be paid for domestic concentrates with a few minor exceptions.

Atomic Power Plant for West Coast

A \$61,000,000 atomic-powered electric generating plant has been proposed by Pacific Gas & Electric Co. for erection at Bodega Bay, 50 miles north of San Francisco. The company's plans call for a 325,000-kw plant with construction to begin in August 1962. It will be the world's largest such plant. When placed in operation in December 1965, the company anticipates that it will be able to generate power on a competitive cost basis with that generated in conventional steam plants.

The plant will be powered by a boiling water reactor with capacity for serving a city of 500,000 people. It will utilize a uranium core of suf-

ficient size to keep the plant in operation for $3\frac{1}{2}$ years. The 225-acre site where the plant is to go up will be known as Bodega Bay Atomic Park.

At the end of 1960, there were 163 nuclear reactors of various types operable in the United States. Fifty-two percent of these were used in civilian power, test, research and teaching applications.

Cerro Signs 20-Year Power Contract

Bonneville Power Administration has agreed to sell 90,000 kw of power to Cerro Corporation for a proposed aluminum reduction plant, currently under study, near Wauna, Ore., according to a 20-year contract recently signed by the company. The agreement covers power requirements for a two-potline, 55,000 ton per year capacity plant, and calls for delivery of power not later than September 1, 1963. Cerro may withdraw from its commitment, under certain conditions, prior to the end of 1961.

Western Gold & Uranium, Inc., proposes to build this 18-story, 600-room hotel overlooking the Grand Canyon in Arizona. The company owns a 20-acre segment of the South Rim, where it's Orphan uranium mine is situated 1800 ft beneath the eastern edge of the proposed hotel would have a view of the Grand Canyon, which at that point is 12 miles wide and one mile deep

Cerro has an option on a 1030-acre plant site near Wauna which is on the Columbia River.

An earlier contract between Bonneville Power and United Pacific Aluminum Corp. for a proposed plant at Longview, Wash., has been replaced by the new agreement. United Pacific was acquired by Cerro earlier this year.

ALSO . . .

One hundred twenty six beryllium claims in the Spors Mountains, Utah, area have been optioned to FMC Corp., which changed its name from Food Machinery and Chemical Corp. on July 1. Known as the Hedman claims, they are said to be located in a geologically favorable setting for beryllium mineralization. An exploration program is now getting under way at the property.



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THE REPORT CORNER

Recent Publications of Interest to Mining Men

USBM IC 8031. "Recommended Procedures for Mine Hoist and Shaft Installation, Inspection, and Maintenance," by W. Dan Walker, Jr., and R. W. Stahl.*

USBM IC 8014. "Tungsten Deposits in Utah," by F. D. Everett.*

USBM RI 5797. "Comparative Studies of Explosives in Marble," by Thomas C. Atchison and Julius Roth.*

USBM RI 5794. "Cleaning Trials on Subbituminous Coal Containing Bentonitic Clays from Lewis and Thurston Counties, Wash.," by H. F. Yancey and M. R. Geer."

USBM RI 5793. "Flotation Studies on Copper-Nickel Sulfide Ores from Deposits Near Rockport, Maine," by John E. Shelton.*

USBM RI 5712. "Titanium-Bearing Deposits in South Texas," by A. D. Hahn, W. C. Miller, and M. M. Fine.*

USBM RI 5729. "Beneficiating Spodumene from Pegmatites of Gaston County, N. C.," by James S. Browning and Thomas L. McVay.*

* Available from Publications Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa.

USBM RI 5669. "Particle Statistics of Infinite Population as Applied to Mine Sampling," by R. M. Becker and Scott W. Hazen, Jr. Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price: 45 cents.

USGS Bulletin 1101. "Vanadium-Uranium Deposits of the Rifle Creek Area, Garfield County, Colorado," by Richard P. Fischer, with a section on "Mineralogy" by Theodore Botinelly. For sale by Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Special Report 65. "Geology of the San Bernardino Mountains North of Big Bear Lake, Calif.," by James Frank Richmond, with a Tabulated list of mines and mineral deposits, by Cliffton H. Gray, Jr. California Division of Mines, Department of Natural Resources, Ferry Bldg., San Francisco. Price: \$1.50.

Information Circular 4. "Directory of Rock and Mineral Producers in Virginia," compiled by D. C. LeVan and R. F. Pharr. Department of Conservation & Economic Development, Box 3667, University Station, Charlottesville, Va. ALSO . . .

A rock fall in the Kemano tunnel, which supplies water for power generation at the Kitimat, B. C., aluminum reduction plant of Aluminum Company of Canada Limited is scheduled to be cleaned up by the first week in September. The ten-mile long tunnel was drained in mid-June in order that the suspected rock obstruction could be removed. Cost of removing the rock fall and restoring the tunnel to operation is estimated at about \$2,000,000.

Core drilling by Leprechaun Mining and Chemical Co. near Silver Peak, Nev., has revealed what is termed a "major brine lithium reserve" that contains an extensive potash deposit. Cesium and rubidium are also reported present in the deposit. The company plans to build a pilot plant to test recovery methods.

An exploration project at the Carbonate mine in Lewis and Clark County, Montana, has been approved by the Office of Minerals Exploration. Swansea Mines, Inc., will explore for lead-zinc at the property with the project cost placed at \$18,260.

Union Pacific Railroad Co., is investigating the feasibility of establishing an iron ore plant near Laramie, Wyo. The plant would process titaniferous ores from a deposit located at Iron Mountain in the southeastern part of the state.

Columbia Iron Mining Co., a U. S. Steel Corp. subsidiary, has taken an option on the Klukwan iron ore property near Haines, Alaska. The property consists of 91 lode claims, 92 placer claims and about 970 acres, either owned outright or held on leases.

The joint-venture beryllium oxide plant of Beryllium Corp., and United Technical Industries, Inc., at Delta, Utah, is nearing completion. With a design capacity of 25,000 lb of beryllium oxide per month, the plant will chemically treat ores from the Spors Mountain area about 50 miles away.

A 20,000 ton per year aluminum smelter will be built at Veracruz, Mexico, by Alumino of Mexico. The project, which was originated by Intercontinental, S. A., of Mexico City, and Aluminum Co. of America, will involve expenditures of about \$16,500,000. Raw materials for the plant will be imported.

IT'S A FACT*

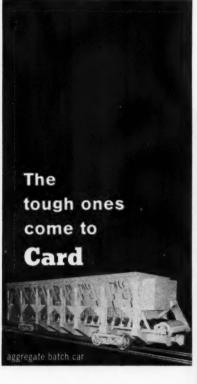


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SPECIAL EQUIPMENT IS A CARD SPECIALTY



sinking cross-head

Contractors and underground operators throughout the West have come to Card for economical solutions to their needs for unusual and one-of-a-kind haulage equipment.

A few examples are shown here: 5-yard transit-mix car for underground concreting; 22-compartment aggregate batch car with hydraulic gates and built-in conveyor unloader; sinking cross-head with full safety mechanism for best mine safety practices in shaft sinking; movable shaft pouring forms.

transit-mix car

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want reliable equipment, properly designed to the job required, built for the lowest possible cost and ready when needed, make Card your choice. Our engineers are ready to serve you.



Federal-Gas Hills Partners is developing substantial new reserves of uranium ore at its properties in the Gas Hills area of Wyoming. Stripping of the deposits is currently under way. The company expects to strip about 5,000,000 cu yd of waste in developing the ore, which will be mined from four interconnected pits. The new reserves are about six miles from the company's mill, whereas current production is largely from three pits 17 miles away.

Sabre-Pinon proposes to acquire a 72.75 percent interest in Homestake-New Mexico Partners. Shareholders of Sabre-Pinon are being asked to vote on the company's plan to acquire Hidden Splendor Mining Company's interests in Homestake-New Mexico Partners at a cost of about \$3,000,000. Sabre-Pinon also proposes to acquire holdings of United Western Minerals Co., J. H. Whitney & Co., White, Weld & Co., and San Jacinto Petroleum Corp., in the Partners venture, leaving Homestake Mining Co. and Clyde Osborn, who is general manager of the operation, holding the 27.25 balance.

According to Ed Clark, director of the Natural Resources Department for the State of Colorado, a group of men from outside the state have raised money to experiment with the underground conversion of coal into gas. The experiment calls for burning coal underground in an oxygen-deficient atmosphere, and then piping the created gas to market.

Lance Corp. has completed a 42-in. diam ventilation shaft at its Black-jack No. 1 mine near Grants, N. M. Drilled by rotary methods, the shaft is 640 ft deep and is lined with 36-in. ID pipe. It was completed in two weeks. The mine produces about 15,000 tons per month and is described as being very dry, which is in contrast with the many wet mines in the Grants area.

A vein of silver ore has been uncovered in a heretofore little explored zone of the Galena mine near Wallace. Idaho. An exploration drift on the 3200-ft level has encountered a downward extension of the vein of high grade ore first disclosed in 1959 on the 3000-ft level. The vein lies north of the Polaris fault and represents an ore zone separate and distinct from the silver vein which has provided the preponderance of the ores mined since the mid-Fifties. Work on the new showing continues. American Smelting & Refining Co., which encountered the strike, leases 1044 acres of the Galena property from Callahan Mining Corp.

manufacturers forum

THE AUTOMATIC AND CON-TINUOUS ELIMINATION OF WA-TER AND OIL CONDENSATION from compressed air lines without causing pressure drop has reportedly been solved by the use of the "Moisture Minder" a new valve from the Barger Manufacturing Co., 204 Foshay Tower, Minneapolis 2, Minn. The valve takes advantage of the pressure in the system to perform the function of removing condensed moisture from the air system. The unit is just under six in. in length; 11/4 in. in diam and is threaded to fit standard 1/4-in. pipe. In typical installations, the Moisture Minder is attached to existing filter bowls, drop legs, after coolers and compressor points.

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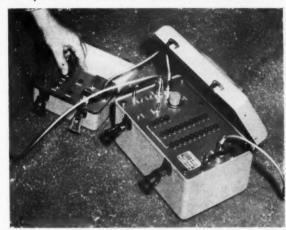
AL

A LINE OF NOZZLES made especially to cut costs of high capacity, low pressure installations has just been announced by Bete Fog Nozzle, Inc., of Greenfield, Mass. Employing the conventional whirl principle of spray generation, the new nozzles are made from one piece of material rather than two pieces as in previous designs. They are made with ½ in. male pipe thread. Nine models cover a capacity range of 2 to 8 gpm at 40 psi, and the spray pattern of each is an 80° hollow cone. They are available in brass, teflon and other machineable materials.

A DEVICE FOR AIR COMPRES-SORS, known as the Trymatic Governor, and manufactured by Trymac Inc., 16 W. 5th St., Erie, Pa., continuously maintains receiver pressure within one lb of any given setting while the compressor is in operation. It has only one self-actuated moving part; and is said to require no internal adjustments, cleaning, lubrication, or other maintenance. The governor keeps the motor load in direct proportion to the air demand, resulting in a lower over-all load factor, and it is handily installed on any compressor using conventional regulating equipment and unloading inlet valves. The unit fits into standard tubing or piping on the compressor.

A BLASTING DEVICE WITH SEISMIC TIMER for determining bedrock depths in deep mineral explorations and over burden studies is available from

DynaMetric Inc., 2955 E. Colorado Blvd., Pasadena, Calif. Determinations up to 100 ft or more can be made with the Timer using an instrumented sledge hammer to generate the seismic shock wave. The Blaster, only 4 by 7 in., is a battery-operated, capacitor-discharge type. It has a built-in circuit tester, ready light, and posi-



tive, three-switch safety feature, and is available in two-cap capacity, for seismic work, or in multi-cap capacity for larger shots.

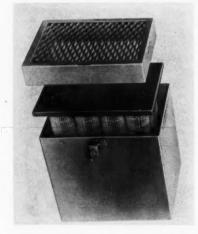
A RUBBER TIRED PUSHER DOZER, Model D-500, is the latest addition to the line of such vehicles manufactured by The Frank G. Hough Co., Liberty-ville, III. The newest equipment weighs over 100,000 lb and has undergone extensive field tests in actual on-the-job locations for more than a year. Among the major features of the D-500 is the full hydraulic-articulated steer-

ing which provides a turning radius of 25 ft, less than its overall length. The vehicle is powered by a 700-hp turbo-charged, V-12 Cummins diesel engine, reduced to 600 hp at 1200 rpm. The power train includes a full power-shift trans-



mission that requires no stopping for range shifts, and which is a full-reversing, constant-mesh type with speed ranges up to 15 mph in both forward and reverse. Power-transfer differentials on both axles provide optimum traction. The D-500 has 4-wheel air-controlled brakes with dual brake pedals. It is equipped with a blade 160 in. wide extending 10 in. beyond each side of the wheel path; the six way hydraulic blade control permits lifting and lowering and side-to-side tilt as well as forward and backward pitch. Dry ballast material is used on all four tires to assure smoother more stable riding, and there is a walk-in-type cab.

A SINGLE-STAGE DRY TYPE ENGINE AIR CLEANER, the Farr Pamic Air Cleaner, is now available in 12 standard sizes for truck, tractor, and stationary engines ranging in power from ten to over a thousand hp. Manufactured by Farr Co., P. O. Box, 90187, Airport Station, Los Angeles 45, Calif., the Pamic assembly consists of a rectangular housing and a

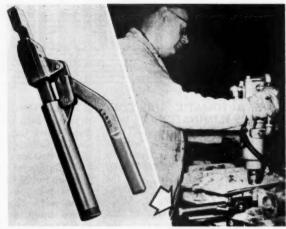


new modular type filer cartridge. The rectangular shape allows room for more filter paper to increase the dirt holding capacity and lowers pressure loss for the air intake system. The face plate of the Pamic disposable cartridge is a rubber-like plastic into which the filter paper is molded. Face plate forms an integral air seal when locked in place in the housing, thus eliminating need for spare gaskets or seals. There are two models of the Cleaner: "R", equipped with an ex-panded metal grille called a Retainer Frame to lock the disposable cartridge in the housing; "M", which includes a Moisture Eliminator (instead of the Retainer) to prevent airborne water droplets from entering the cartridge. Either can be equipped with a rain guard to allow operation in exposed locations.

A TRANSLUCENT BRATTICE CLOTH, made in 20 oz weight, in 36, 48, 54 and 60 in. widths, packed in 25 linear yd rolls, is available from B.E.P. Industrial Equipment, 6346 West MacNichols Road, Detroit 21, Mich. Made from polyvinyl chloride, a material which does not support combustion and is self extinguishing, the brattice is air-proof and waterproof. It is unaffected by damp and does not rot or corrode, features which provide efficient mine ventilation.

A NUT GRIPPER, designed especially for crawler track work, is now available from Rodgers Hydraulic, Inc., Minneapolis, Minn. It has a self-locking

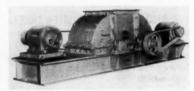
grip that holds the nut with a 7000-lb clamping force, and adjustable jaws accommodating any size of nut from 1/2 in. to 2 in. across the face. Contour of the tool gives easy access to crawler pad nuts. The tool can be used, in addition to track maintenance, on any equipment where tight, rusted, or frozen" bolt



connections pose a problem. Other features are heat-treated tool steel, reversible inner and outer jaws, hardened dowel pins at pivot points, and extra outer jaw for use

on smaller tracks.

A CRUSHER TO ELIMINATE PROBLEMS OF PLUGGING AND CAKING normally found in fine reduction of wet and sticky materials has been released by the Pennsylvania Crusher Division of Bath Iron Works West Chester, Pa. Called the Twin-Rotor Impactor it does its job because of two features: no cage bars or



grates to plug; and the offsetting of its wear liners from the frame so that gas torches can be played into the spaces between the liners and the frame. This new crusher is offered in two sizes for rated capacities to 100 tph when used as a secondary crusher in closed circuit to produce 100 percent minus eight-mesh product. Power requirements vary with particular installations but run as low as 25 hp per rotor. Although it serves best as a secondary crusher for wet clays or shale, it can also be used as a primary crusher and a tailings reducer. Maximum feed size is eight in.

A CUTTER BIT WITH DUAL GAUGE SHOULDER DESIGN and rigid dimensional control, the U21, from Kennametal, Inc., Mining Tool Div., Bedford, Pa., is available in

three standard tip styles: full nose radius style U21, recessed or channel style U21 RA, and cylindrical plug style U21 RA. Dual gauge shoulders on the new bit provide front and rear bearing areas that can absorb the severest shock forces, and a pull-out notch, which replaces the pull-out shoulder of previous bit designs, permits easier, quicker, and safer extraction of tools from blocks on ripper-type chains. Bit stability in the block and positive cutting action is said to be assured by the close fit because of close dimensional tolerances.

A TRIP HOLDER, suitable for preventing the drift of mine cars on level grades or down grades requiring under 10,000-lb holding effort, has been



announced by the Nolan Co., Bowerston, Ohio. Major feature claimed is the elimination of difficulties commonly encountered in the uncontrolled movement of mine cars during automatic loading.

William E. Goodman has retired as chairman of the board of directors, Goodman Mfg. Co., Chicago.

Succeeding him is Howard Goodman who continues as president and chief executive officer, a post he has held since 1958. Appointed as executive vice-president is John S. Newton, who in addition to



W. E. Goodman

being responsible for mine machinery engineering and development, will devote attention to the coordination of the company's engineering and manufacturing activities.





H. Goodman

J. S. Newton

W. E. Goodman's initial contact with the mining industry dates back to 1920 when he accepted a job in the engineering department of the Goodman company founded by his father in 1900. He progressed through the ranks becoming president in 1939 and chairman of the board and president in 1955. Over the years he has been closely identified with the American Mining Congress, serving as a member of the board of governors, manufacturer's division, for several years and taking an active part in its committee work. A most recent assignment is that of chairman of a committee on cooperation with government agencies. He will continue to be a member of the Goodman company's board of directors and will act as a consultant in company affairs.

Jack H. How, president of Western Machinery Co. headquartered in San Francisco, has been elected to the Board of Directors of Arthur G. McKee and Co. of Cleveland, Ohio.

Western Machinery Co., whose operations are conducted by its Western Knapp Engineering Co. and WEMCO divisions, became a wholly owned subsidiary of McKee in January 1961.





P. C. Mitchell

J. C. Willey

P. C. Mitchell and J. C. Willey have been named to the board of directors of Harbison-Walker Refractories Co. Mitchell has been vice president-mining for Harbison-Walker since 1953, and has been with the company since 1922. Willey, formerly assistant to the president and managing director of the company's Peruvian subsidiary, succeeds his father, Raymond Willey, as a director.

Shannon C. Powers has been elected vice president and general manager of the National Electric Division, H. K. Porter Co., Inc. He has spent his entire career in the electrical industry and was vice president and general manager of Peerless Electric Co. at the time of its acquisition by Porter in 1959.

Charles L. Foss has been appointed assistant to the president of Security Engineering, blast hole bit manufacturers for the mining and quarrying industries. Foss comes to his new post from Dresser Manufacturing, like Security Engineering, a division of Dresser Industries.

Roy K. Haugseth, formerly manager of production planning and control at the South Milwaukee (Wis.) Works of Bucyrus-Erie Co., has been appointed superintendent of manufacturing at the company's Evansville (Ind.) Works. He has been succeeded at South Milwaukee by William B. Winter, former general foreman-plate and weld.

T. B. Applewhite has been appointed product sales manager of conveyor belting products for United States Rubber Co.

Robert B. Booth has been appointed by American Cyanamid Co. to become manager of the mining chemicals research and development section and will be located at the Cyanamid research center in Stamford, Conn. He is the author of many U. S. patents in the field of mining chemistry.

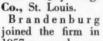
Max J. Kennard has been appointed business development engineer by the Parsons-Jurden Corp.,

New York City mining, metallurgical and industrial engineering subsidiary of the Ralph M. Parsons Co., Los Angeles engineers constructors. Kennard was formerly a vice-president of Southwestern Engineers.



neering Co. and of Combined Metals Reduction Co. Until recently Parsons-Jurden was Anaconda-Jurden Associates, a subsidiary of the Anaconda Co., with the name being changed when acquired by Parsons.

W. Charles
Brandenburg has
been appointed
manager of mining
sales for the Electrical Products Division of Joy Mfg.
Co., St. Louis.





1957 as a sales engineer. His experience has been extensive in the electrical field, particularly involving electrical products manufacturing, commercial, residential and industrial construction, coal mine installations and electrical utilities systems.

The Okonite Co., Passaic, N. J. has announcd the appointment of Robert B. Blodgett as director of research and Richard C. Waldron, with Okonite since 1928, as chief engineer.

N. J. (Nick)
Decker, general
works manager of
Koehring Division
and a 37-year veteran with Koehring Co., Milwaukee, Wis., retired
recently.



As general works manager, Decker

had been in charge of manufacturing for both the Koehring Division plant in Milwaukee and the Koehring Southern plant in Chattanooga, Tenn. Since joining Koehring in 1924, Decker had held various engineering and manufacturing posts.

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CATALOGS & BULLETINS

SUMP PUMP MOTORS. General Electric Co., Schenectady 5, N. Y. Available in both standard and deluxe models are GE's sump motors, 1/3 hp, 1725 rpm which are described in Bulletin GEA-6687A. The booklet introduces motor parts for submersible sump pump applications with brief presentation of how manufacturers can increase their contribution and profits by using motor parts. The construction features of the motors are pointed up by cutaways and photos, which also illustrate the moisture resistant insulation, rustresistant shaft and permanent lubrication.

BUCKET ELEVATORS. Barber-Greene Co., Aurora, Ill. General information about bucket elevator applications and some of the types available from Barber-Greene are contained in the company's latest brochure. Included are standard enclosed vertical, positive-discharge, open inclined, supercapacity, and double-leg grain elevators. Also included are data on both centrifugal-discharge and continuous elevators.

DUST SEPARATOR. The DAY Co., 810 N. E. Third Ave., Minneapolis, Minn. The DAY "HV" centrifugal dust separator described in this 12-page illustrated brochure comes in 20 standard sizes and can handle any volume of air from 150 cfm up. Multiple groupings of the "HV" can be furnished "tailored" to meet a wide range of collection requirements.

MOTORS AND ADJUSTABLE SPEED DRIVES. The Louis Allis Co., 427 E. Stewart, Milwaukee, Wis. Application photographs showing Louis Allis motors in use on shuttle cars, conveyors, vibrating ma-

chines, spin dryers, car shakers and drying machines are shown in Bulletin #116. In addition to application information, the brochure also describes the various drive systems that can be used for operating coal mining equipment.

HOLE DRILLING RIGS. Le Roi Div., Westinghouse Air Brake Co., Sidney, Ohio. Le Roi has issued two bulletins describing a new line of blast hole drills from 2½ to 73% in. hole size. The LRD-3 is a top drive machine designed to drill 100 ft in depth, while the LRD-2 is a lighter rig and drills 30 ft in a single pass with direct drive through the rotary table. Both models can be truck, crowbar or wheel mounted.

EYE PROTECTION. Mine Sajety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa. The Skullgard Eyeshield provides non fogging eye protection, adapts to all types of head protection and is described in Bulletin No. 0302-5. The protective facilities are afforded through the hinged type plastic shield, either clear or green tinted, which flips into position to protect against flying particles or splashes and pushes out of the way when not needed.

VIBRATING SCREEN. Koehring Co. of California, 2200 Country Club Blvd., Stockton, Calif. A Twin Shaft vibrating screen just announced by the company is featured in a new brochure. The brochure presents a graphic story of how the double shafts produce a uniform pulsation over the entire length of the screen, preventing "gallop" and providing higher capacity. The Twin Shaft is available in three sizes: 4 in. by 8 in.; 4½ in. by 10 in.; and 5 in. by 14 in. Other features detailed in the booklet are: bolted screen cloth to eliminate welding tensions; removable lower deck to

permit use of a single deck screen; all belt sheaves eccentrically bored to counteract whip, and adjustable bearing cartridges without disassembly.

CONVEYOR BELTING WALL CHART. Department WC, Hewitt-Robins, Stamford, Conn. The company has issued a wall chart pointing out various ways to cut down on costly wear and tear of conveyor belting through proper maintenance procedures. Subjects covered are:.storage; record keeping; alignment; impact idlers; drive pulley lag; loading chute; skirting rubber; automatic switches; inspection schedules; lubrication, fasteners and repair. A brief description of the composition of belting is provided.

SCRUBBERS. The W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland 1, Ohio. Sly's new "Impinjet" Scrubbers for wet cleaning, absorption or cooling of gases resulting from a wide variety of industrial processes is detailed in Catalog 150. Shown and described is the inpingement baffle plate design that is the key to high cleaning efficiency with minimum power and liquid consumption. A cutaway drawing shows the flow of gas through the scrubber. Dimensions are given for standard single and multiple stage units in capacities of 1000 to 3,800 cfm.

COAL BLENDING. B-I-F Industries, P. O. Box 276, Providence, R. I. A data sheet, accompanied by illustrative and descriptive bulletins, has just been issued by this company covering the problem of blending high and low volatile coals to prevent excessive expansion in coke ovens. Description is facilitated through the use of schematic diagrams, product photographs, and short factual text.

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